THE MECHANICS' MAGAZINE, MUSEUM, Register, Journal, AND GAZETTE,

JULY 5TH—DECEMBER 27TH, 1845.

EDITED BY J. C. ROBERTSON.

VOL. XLIII.

"Invention follow'd in her brilliant train,
From each new truth new usefulness to gain;
From all the elements Discovery drew
The inmost secrets veil'd from mortal view:
And apt Invention, watchful by her side,
Each, as it rose, to man's delight applied;
Employ'd the water, caught the unwilling wind,
And made strong fire the slave to stronger mind,
Mingled contending elements at will,
Curb'd and restrain'd, and made them each fulfil
Its destined purpose in her curious plan,
All for the service and the ease of man.
And, chief of triumphs, in a happier hour,
Chanced on the secret of the mighty power
That sleeps conceal'd in every drop that flows
Round the huge earth, or freezes in its snows.
Discovery smiled with wonder at the sight,
And brisk Invention seized it with delight.
And lo! puissant steam, a servant mild,
Titan in force, but duteous as a child,
Put forth for man a strength unknown before,
And raised with mighty arms the ponderous ore,
Plied the quick shuttles in the weaver's room,
Sparing his strength, while it enrich'd his loom;
Whirl'd its great wheels triumphant o'er the deep,
Though tides and winds were adverse or asleep;
And on the land, along the assisting rail,
Drove its hot chariot swifter than the gale."

Mackay's Hope of the World.

LONDON:

ROBERTSON AND CO.

MECHANICS' MAGAZINE OFFICE, 166, FLEET-STREET.

AGENTS: FOR EDINBUBGH, J. SUTHERLAND;
GLASGOW, W. R. M'PHUN, AND DAVID ROBERTSON;
DUBLIN, MACHEN AND CO., 8, D'OLIER STREET;
PARIS, A. & W. GALIGNANI, RUE VIVIENNE;
HAMBURGH, W. CAMPBELL;

AND REGULARLY SUPPLIED BY ALL BOOKSELLERS AND NEWSMEN IN TOWN AND COUNTRY.

1845.

PRINTED AND PUBLISHED BY J. C. ROBERTSON, 166, FLEET STREET.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1143.] SATURDAY, JULY 5, 1845. [Price 3*d.*

Edited by J. C. Robertson, No. 166, Fleet-street.

MR. BIRAM'S IMPROVEMENTS IN OSCILLATING ENGINES.

Fig. 1.

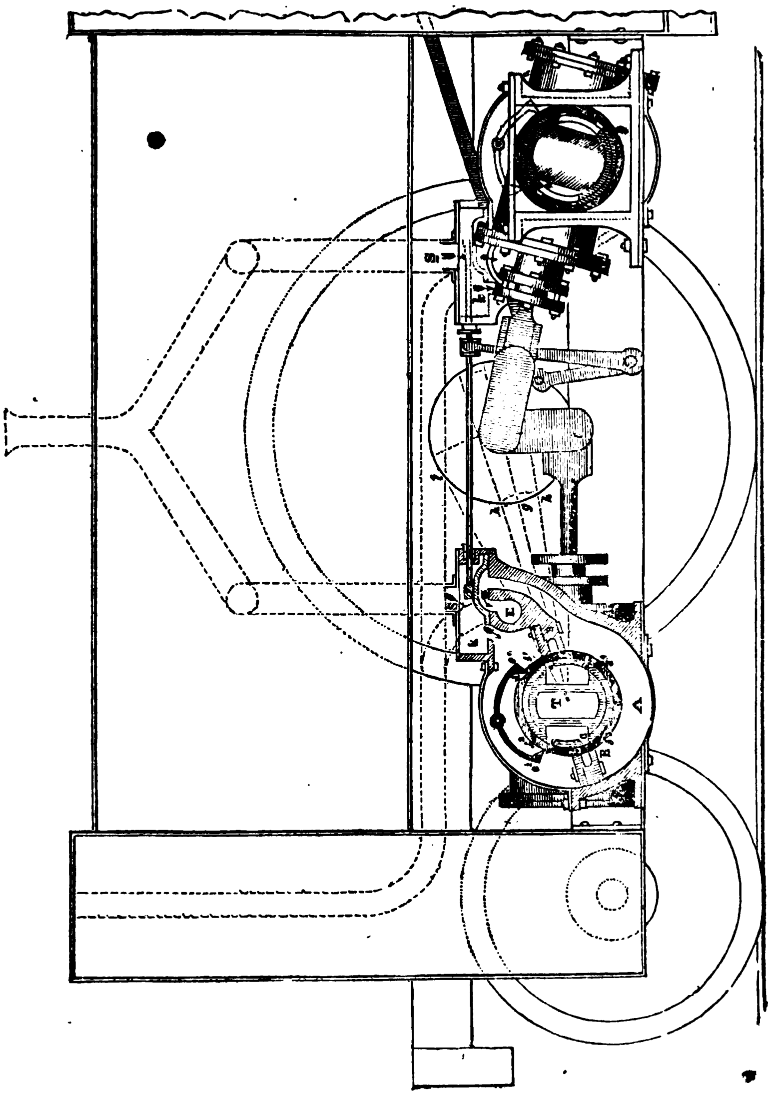
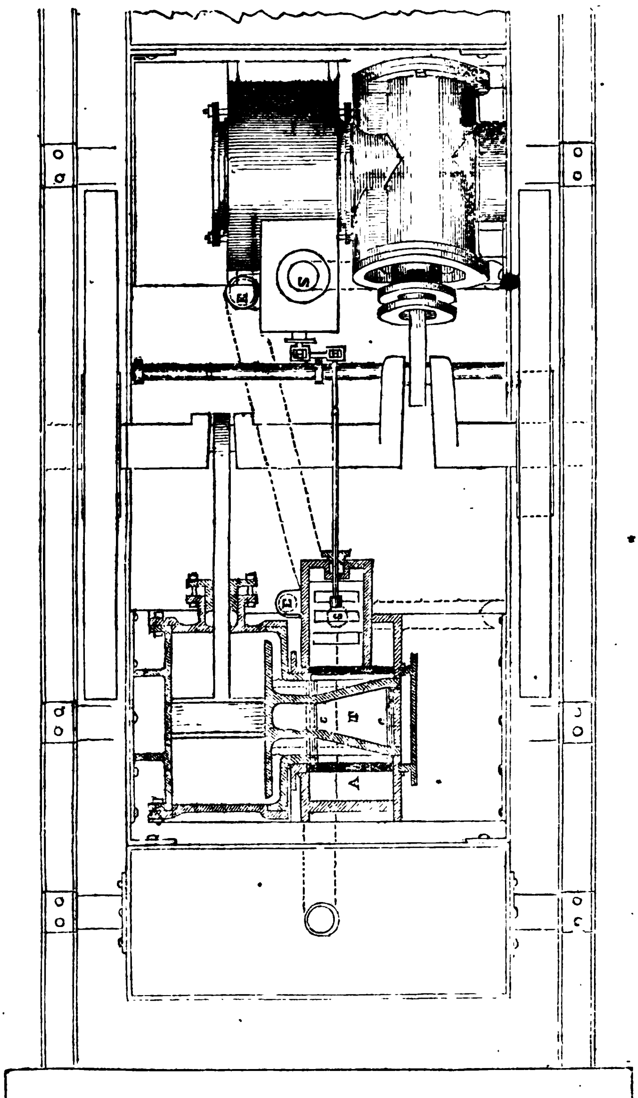


Fig. 3.



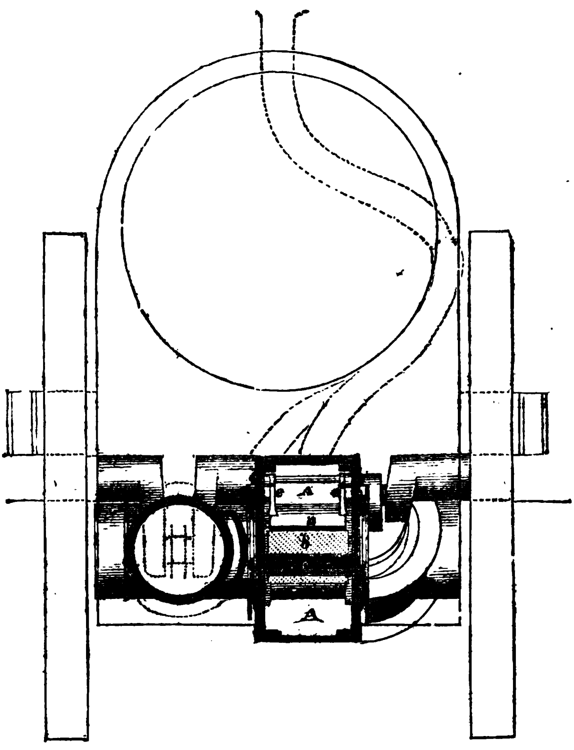
Besides the arrangement which we described in our last Number, Mr. Biram gives another, in which the ports are opened and shut by means of valves acted upon by tappets projecting from the trunnion; but the details of this we pass over, as the general system of action is the same in both cases.

Whichever of these arrangements is adopted it will obviously make no difference whether the engines are worked by steam, water, or any other fluid, or whether they are stationary or locomotive; or whether they are fixed horizontally, or at any angle with the horizon.

The accompanying figures show the system as applied according to the first arrangement, to the propelling of a railway locomotive carriage. Fig. 1 is a side elevation, partly in section, of the engines; fig. 2, an end elevation; and fig. 3, a plan. The engines are proposed to be placed fore and aft, and worked in connection by means of double cranks.

Mr. Biram illustrates the advantages of his system by several other exemplifications. In one it is applied to the water supply pump of a locomotive engine, worked by an eccentric on the shaft of the driving-wheels. In another it is adapted to a fire-engine, whereby "the same work would be performed with one cylinder, which is now done by two of the same diameter, the friction would be reduced one-half, and a rotary mode of working be substituted for the reciprocating." Another arrangement for adopt-

Fig. 2.



ing the system to a fire-engine is shown, in which an upright lever is introduced nd the piston worked by a rowing action, hich is allowed on all hands to be the best f any. Mr. Biram observes farther of this ast arrangement, "It is also well-adapted r a ship's pumps, in which case the ipe above the valve-box should be coneyed through the ship's side, as near as onveniently may be above the load ater line; it will be also evident that, y attaching a horizontal rod to the end the upright lever, and passing handles through it at convenient distances (say about a yard asunder), a great number of men might be conveniently employed at the same pump; and further, that by attaching an air vessel, it would at once become a powerful fire-engine, by which the water could be sent to any part of the vessel." Mr. Biram's last exemplification is an air-pump, "by turning the handle of which in one direction, it is a condensing pump; and by reversing the motion, it becomes an exhausting one."

Mr. Biram's claim is—1st, to "the con-

Here, then, we have the side F H expressed in known terms, but F D is equal to F H; hence it follows, that in the plane triangle F C D, all the sides are given to determine the angle subtended by the side F D, and the writers on trigonometry have shown that the formula for that purpose is,

$$\cos. F C D = \frac{C F^2 + C D^2 - F D^2}{2 C F . C D}\text{; that is,}$$

$$\cos. b. = \frac{\sec.^2 a + \sec.^2 c - \tan.^2 a - \tan^2 c \mp 2 \tan. a \tan. c \cos. B}{2 \sec. a \sec. c};$$

but by the property of the circle in reference to the secant and tangent of an arc or angle, we have $\sec.^2 a - \tan.^2 a = 1$, and $\sec.^2 c - \tan.^2 c = 1$; therefore by substitution,

we get $\cos. b = \frac{1 \mp \tan. a \tan. c \cos. B}{\sec. a \sec. c}$; from which last form by the theory of angular sections, we finally obtain

$$\mp \cos. b = \mp \cos. B \sin. a \sin. c \mp \cos. a \cos. c.$$

This, then, is the final form of the equation, for calculating the direct distance between any two places on the surface of the earth, where it must be observed, that a is the complement of one latitude, and c that of the other, and that the *minus* or *plus* sign is to be employed, according as the angle B, or the side a or c is greater or less than ninety degrees, the cosines of angles between 90° and 180° being negative.

The same formula, it is manifest, will apply to the determination of the distance between the sun and moon, or between the moon and a fixed star, when their right ascensions and declinations are known; so that this problem, when taken in connexion with that at page 410, vol. xlii., constitutes one of the best methods of finding the longitude of a ship at sea, and that which is generally known to seamen by the name of *Lunar Observations.* Our present object, however, is only to determine the distance between places on the earth, and for this purpose, we must consider the problem under the various cases into which it naturally divides itself, and these are:

1. When the latitudes are both north or both south, and the sum or difference of the longitudes less than ninety degrees or a right angle.

2. When the latitudes are both north or both south, and the sum or difference of the longitudes greater than ninety degrees or a right angle.

3. When the latitudes are, the one north and the other south, and the sum or difference of the longitudes less than ninety degrees or a right angle.

4. When the latitudes are, the one north and the other south, and the sum or differences of the longitudes greater than ninety degrees or a right angle.

These are the four distinct cases of the problem, and the method of applying the above general formula to the resolution of each case, will become manifest from what follows.

EXAMPLE 1. What is the direct distance in English miles, between St. Paul's Church at Liverpool, and the pillar in the Dockyard at Halifax, North America, the latitudes being respectively 53° 24′ 36″ and 44° 39′ 24″ north, and the longitudes 2° 59′ 30″ and 63° 37′ 30″ west of Greenwich?

Here the latitudes are both north and the longitudes both west, which corresponds to the first of the preceding cases, and also to that represented by the construction; for since the longitudes are both of one name, the angle contained between the meridians of the two places is equal to the difference of the longitudes, and being less than ninety degrees, the conditions of the first case are completely satisfied. The operation is therefore as follows:—

Longitude of Halifax	63°	37′	30″	West.						
Longitude of Liverpool	2	59	30	West.						
Diff. of longitudes......	60	38	0	......	Log. cos.	9·690548				
Latitude of Halifax ...	44	39	24	......	Log. cos.	9·852072	...... Log. sin.	9·846867		
Latitude of Liverpool	53	24	36	......	Log. cos.	9·775308	...... Log. sin.	9·904673		
Nat. num................	+ 0·20793			......	Log.	9·317928	...... Log. sin.	9·751540	Nat. num.	+ 0·56434
	+ 0·56434 add									
Nat. cos. b =	+ 0·77227;									

therefore we have $b = 50° \; 38' \; 30'' = 3038·5$ geographical miles; but the geogra-

phical mile is to the English mile, as 1·15 to 1 very nearly; hence we have 3033·5 × 1·15 = 3488·5 English miles, for the direct distance between Liverpool and Halifax.

Note.—The above process is not precisely that which is indicated by the formula; but it is tantamount to it, and saves the trouble of a subtraction in taking the complements of the latitudes, for it is obvious, that the sine of the complement is the same as the cosine, and the cosine of the complement the same as the sine.

EXAMPLE 2.—What is the direct distance between the Observatory of Paris, in latitude 48° 50′ 12″ North, and longitude 2° 20′ 30″ East, and Cape Churchill, in latitude 58° 48′ North, and longitude 93° 12′ West?

Here the latitudes are both north, and the longitudes one east and the other west; consequently, the sum is the angle contained between the meridians of the places; and being greater than a right angle, it agrees with the second case. Hence it is—

Longitude of Cape Churchill......	93° 12′ 0″ West.			
Longitude of Paris Observatory..	2 20 30 East.			
Sum of the longitudes...............	95 32 30 ...	log. cos. 8·984840		
Latitude of Cape Churchill.........	58 48 0 ...	log. cos. 9·714362 ...	log. sin. 9·932151	
Latitude of Paris Observatory ...	48 50 12 ...	log. cos. 9·818363 ...	log. sin. 9·876700	
Nat. num.	0·32927 sub. ...	log. 9·517555	log. 9·808851	nat. num. +0·64395
	+0·64395			
Nat. cos. b =	+0·31468			

therefore, we have b = 71° 39′ 30″ = 4299·5 geographical miles, or 4944·4 English miles, the distance sought.

EXAMPLE 3.—What is the direct distance between St. Paul's church, at Liverpool, the latitude and longitude being as in the first example, and Fort Villagagnan, in Brazil, the latitude being 22° 54′ 42″ South, and longitude 43° 9′ West?

Here the latitudes are the one North and the other South, and the longitudes both West; and since their difference is less than 90°, the example falls under the third case. Hence it is,

Longitude of Fort Villagagnan ...	43° 9′ 0″ West.			
Longitude of St. Paul's, Liverpool	2 59 30 West.			
Difference of the longitudes.........	40 9 30 ...	log. cos. 9·883244		
Latitude of Fort Villagagnan	22 54 42 ...	log. cos. 9·964310 ...	log. sin. 9·590297	
Latitude of St. Paul's, Liverpool..	53 24 36 ...	log. cos. 9·775308 ...	log. sin. 9·904673	
Nat. num....................................	+0·41962	log. 9·622862	log. 9·494970	nat. num. −0·31259
	−0·31259 subtract.			
Nat. cos. b =	0·10703;			

therefore, we have b = 83° 51′ 20″ = 5031·3 geographical miles, or 5786 English miles, the distance sought.

EXAMPLE 4.—What is the direct distance between Fort Villagagnan, in Brazil, the latitude and longitude being as in the last example, and the western extremity of the island of Socotra, of which the latitude is 12° 33′ North, and longitude 53° 23′ East?

In this example both the latitudes and longitudes are of different names, and the sum of the longitudes is greater than 90°; the example therefore falls under the fourth case, and is thus resolved:—

L—gitude of Fort Villagagnan ...	43° 9′ 0″ West.			
L ngitude of W. extr. of Socotra..	53 23 0 East.			
S n of the longitudes	96 32 0 ...	log. cos. 9·056071		
L tude of Fort Villagagnan	22 54 42 ...	log. cos. 9·964310 ...	log. sin. 9·590297	
L tude of W. extr. of Socotra ...	12 33 0 ...	log. cos. 9·989497 ...	log. sin. 9·337043	
N . num..................................	−0·10230	log. 9·009878	log. 8·927340	nat. num. −0·08469
	−0·08469 add.			
Nat. cos. b =	−0·18699;			

t refore, we have,

$$b = 180° - 79° 13′ 20″ = 100° 46′ 40″ = 6046·66 \text{ geographical miles,}$$

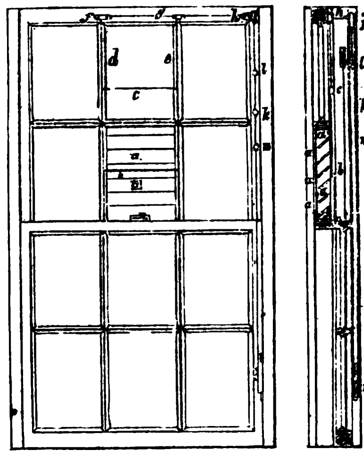
or 6953¾ English miles, the distance sought.

Since these four examples illustrate all the cases of which the problem is susceptible, it is only necessary that the reader should pay particular attention to the signs of the quantities as they arise in these cases, to avoid any error that may result from the different relations of the angular magnitudes.

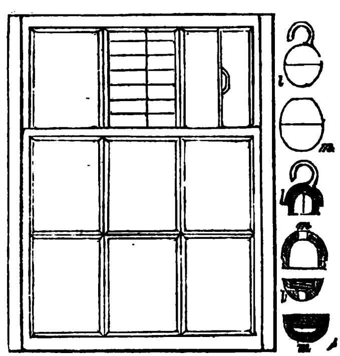
BAILLIE'S PATENT TRANSPARENT SLIDE-VALVE VENTILATOR.

In the ordinary glass louvre ventilators each of the louvres turns on a separate axis, and as long as the whole keep in equally perfect working order, the whole may be opened to any uniform extent, or altogether closed. It rarely happens, however, that the whole remain for any length of time in the same trim; some will not turn as freely, or to the same extent, as others; while one or two will not move at all, either one way or another; the ventilation becomes, in consequence, proportionally inefficient; the streams of air enter at different, often very conflicting angles; and permanent draughts are established where occasional currents only were wanted. In the present ventilator we have all the advantages of the glass louvres, free from any of these objections. It consists, firstly, of a series of louvres, which are *permanently* fixed at a certain inclination, so that the currents of air may be deflected upwards in one uniform direction; and secondly, of a sliding valve, likewise of glass, by which the quantity of air admitted may be regulated at pleasure, and which, when closed, renders the openings perfectly air-tight. The whole is contained in a neat frame, which may be readily adapted by a common glazier to any of the panes of a window.

Fig. A is an elevation and a vertical section of a sash-window, with a ventilator of this description, fixed in the position which experience has proved to be the best for avoiding draughts. *a a* are the fixed glass louvres; *b c*, the slide valve for regulating the quantity of air admitted, which is moved by the cords *d e*, coinciding with, and hidden by, the sash-bars, and passing over pulleys (as at *f g h j*) to any required position. The cord is represented in the figure as being finally passed over a rack-pulley, *n*, in the same way as in ordinary roller-blinds; but when it is



required frequently to pull down the top sash itself, the cord is recommended to be furnished at its lower end with a balance weight, instead of passing over a rack-pulley; *k*, an eye screwed into the sash-bead, through which the cord runs; *l m* are connecting sockets, which serve both to unite the cords, and also to stop (by means of the eye, *k*) the slide valve from being drawn out too far, or let down too violently.



In fig. C the ventilator is shown as fixed in one of the topmost panes of a basement, attic, or other window, where it can be easily reached; here the slide is made to draw out to one side by hand, and the cords, pulleys, &c., dispensed with.

Several advantages besides those before

indicated arise from having the louvres stationary, instead of being moveable. For example:—First, the draught of cold air is avoided, which, in the case of moveable louvres, enters through the intervals that are required to be left between their ends and the sides of the frame. Secondly, the apparatus has no joints, nor other working parts, where the dust can accumulate and become hardened, so as to obstruct their action. It may be closed in a perfectly air-tight manner, even in the most dusty situations. Thirdly, its construction is so simple, that nothing but rough usage can injure it; and if out of order, it may be repaired by any ordinary workman. And fourthly, the cord or line by which the sliding valve is opened and shut (when such is used) may be carried to any part of a room, such as the bed-side, in the same manner as a bell-rope.

We have had one of these ventilators fixed for some time in our own office, and should be wanting in thankfulness for the comfort it has afforded us, were we not to recommend it warmly to our friends.

BRITISH ASSOCIATION—CAMBRIDGE MEETING, 1845.

Sir John Herschel, President.

[Selections from the Reports of the proceedings in the *Athenæum* and other journals.]

Barometrical Pressure.—New Discovery Expedition.

The Antarctic Voyage of Sir James Ross has conferred a most important accession to our knowledge in the striking discovery of a permanently low barometric pressure in high south latitudes over the whole Antarctic ocean—a pressure actually inferior by considerably more than an inch of mercury to what is found between the tropics. A fact so novel and remarkable will of course give rise to a variety of speculations as to its cause; and I anticipate that it will furnish one of the most interesting discussions which have ever taken place in our Physical Section.. The voyage now happily commenced under the most favourable auspices for the further prosecution of our Arctic discoveries under Sir John Franklin, will bring to the test of direct experiment a mode of accounting for this extraordinary phenomenon thrown out by Colonel Sabine, which, if realized, will necessitate a complete revision of our whole system of barometric observation in high latitudes, and a total reconstruction of all our knowledge of the laws of pressure in regions where excessive cold prevails. This, with the magnetic survey of the Arctic seas, and the not improbable solution of the great geographical problem which forms the chief object of the expedition, will furnish a sufficient answer to those, if any there be, who regard such voyages as useless. Let us hope and pray that it may please Providence to shield him and his brave companions from the many dangers of their enterprise, and restore them in health and honour to their country.—*The President's Address.*

Repeal of the Glass Duty.

A very great obstacle to the improvement of telescopes in this country has been happily removed within the past year by the repeal of the duty on glass. Hitherto, owing to the enormous expense of experiments to private individuals not manufacturers—and to the heavy excise duties imposed on the manufacture, which has operated to repress all attempts on the part of practical men to produce glass adapted to the construction of large achromatics, our opticians have been compelled to resort abroad for their materials—purchasing them at enormous prices, and never being able to procure the largest sizes. The skill, enterprise, and capital of the British manufacturer have now free scope, and it is our own fault if we do not speedily rival, and perhaps outdo, the far-famed works of Munich and Paris. Indeed, it is hardly possible to overestimate the effect of this fiscal change on a variety of other sciences to which the costliness of glass apparatus has been hitherto an exceeding drawback, not only from the actual expense of apparatus already in common use, but as repressing the invention and construction of new applications of this useful material.—*The President's Address.*

Magnetic Machines.

Dr. Scoresby described a large magnetic machine which he had constructed, with some results of its action. The principal part of the machine consists of two cases, or fasciculæ of magnetic bars, of unusually large dimensions, on principles which may be thus summarily stated: 1. That magnetic bars designed for large combinations may be conveniently constructed of various pieces; that the separation of a long bar, say of three or four, into several portions, is not disadvantageous in regard to power, and that the resulting power is similar, whether in the combining of several series of short bars the elementary bars be of the same or of unequal lengths. 2. That the relative powers of magnets, whether single or com-

pound, when different in mass, but proportional in all their dimensions, are not in the ratio of the masses, the large masses being less strong proportionally than the smaller. 3. That whilst magnets of large dimensions are less powerful with respect to their masses than small magnets to which they are exactly proportional in all their dimensions; and whilst the increase of the dimensions continually deteriorates from the energy due to the mass: yet magnets may be combined in such proportional dimensions with a constant increase of power *ad infinitum.* From this last result it follows, that magnets indefinitely small must be indefinitely strong; and may indicate that the mutually attractive forces of the ultimate magnetic elements may be as strong as that by which the metallic elements are themselves combined. It must also be kept in mind that the steel should be perfectly hard; and the elementary plates of the magnet should be made of steel, converted out of one or other of the very best qualities of common iron. All the conditions, with the exceptions of thinness, were attended to in the large magnet constructed by Dr. Scoresby. A magnet on this principle, of the size of the lower mast of a first-rate ship of war, would produce a deviation of nearly 1′ at the distance of a mile, and a sensible effect much beyond that. The electrical effects of Dr. Scoresby's magnet, with a very imperfect armature, were,—it decomposed water, rapidly producing about one cubic inch of the gases a minute; with about sixty-five yards of coiled wire, the effervescence seemed as violent as during the action of dilute sulphuric acid or zink. Copper was deposited from a solution of sulphate of copper at the rate of about 1·2 grain per minute. Shocks and scintillations were thrown out; and sparks were visible in daylight, and emitted audible sounds when the armature revolved so slowly as once in sixteen seconds.

Prof. Forbes had little doubt that Dr. Scoresby could construct very powerful magnets; but he thought that as electro-magnets, so much more powerful, were so readily made, it was almost useless to incur the expense of the others.

Rain Gauges.

A paper was read "on the amount of rain which had fallen, with the different winds, at Toomavara, Limerick, during five consecutive years," by the Rev. T. Knox. Taking the average monthly rain at three inches, the first six months of the year are below the average, the other six months above it. November and July are by far the two wettest months in the year; and in each the greatest amount of rain is from S.W. April is much the driest month; and there is nearly as much rain in it from the northern portion of the compass as from the southern. With regard to the gross amount which fell from each point in the entire year, that which fell from S., S.W., and W., is much above the average; from the other points it is below it. If the polygon which characterizes the yearly rain be divided by a line running N.E. and S.W., then the rain at equal intervals on either side of this line is equal, to all but a fraction of an inch. This is the more remarkable, as these two points had been fixed on by Professor Dove as being the points of greatest and least barometric pressure; that is to say, the wind being supposed at S.W., any shift of it either towards S. or W. produces a rise of the barometer, and also any shift on either side of N.E. a corresponding fall. Now, in the case of the rain, the greatest amount is from S.W., corresponding with the least height of the barometer; the least is from N.E., where also the barometer is highest; and on either side of this line it varies regularly. For instance, the amounts from W. and S. are nearly equal, and both less than that from S.W. N.W. and S.E. are also equal, but still less; and so on. There is one particular in which this separation of the gross amount of rain into the eight portions, as brought by different winds, may be useful; viz., in ascertaining the respective specific gravities, and the amount of saline matter brought from each direction. This may be useful in regard to agricultural matters. For instance, we could easily suppose a case of two portions of land, not many miles asunder, but on different sides of a high range of hills, getting different amounts of salt, from one being exposed to, and the other sheltered from that wind in which the greatest amount was found. But by this mode of collecting the rain, an accurate mode of estimating this is within our reach. To the question, namely, the amount of solid and gaseous matter brought in the rain from each direction, Mr. Knox hopes on a future occasion to turn his attention.

The tables which accompany this communication give the amount of the rain corresponding to each wind, for each separate month in the five years. The following are the yearly mean results, deduced from the whole series.

S.	S.W.	W.	N.W.	N.	N.E.	E.	S.E.
6·548	10·639	6·034	2·789	2·352	2·172	2·251	3·173

Total, 35·958

Mr. Dove said, that according to the hypothesis, that the meteorological phenomena of our latitudes may be explained by two currents, a polar and an equatorial,

which mutually replace each other, a distinction is to be drawn between two kinds of rain, the one caused by refrigeration of the southern current coming into higher latitudes, the other when the southern current in the place of observation is overpowered and replaced by the northern. The first takes place when the vane is S. W., the latter when the vane passes from S.W. through W. to N., or from E. through S. to S.W. The direction N.E. indicates the polar stream without condensation. Hence it follows, that the quantity of rain is a maximum at S.W., a minimum at N.E., and is distributed symmetrically on either side.

The Bishop of NORWICH expressed the satisfaction which he felt at hearing the communication of Dr. Lloyd, and his hopes that extended series of similar observations would soon be put on record. The great and anomalous varieties in the quantity of rain which fell in various localities would, he had no doubt, be found such as to create surprise. Thus, in London the quantity was only 23 inches annually, while in the neighbourhood of his residence it was no less than 33.—Sir JOHN HERSCHEL said that the importance of such observations, when well conducted, could scarcely be over estimated; he believed the discrepancy in the amount of rain which fell in several parts of England was still greater than had been stated by the Bishop of Norwich. If his memory did not deceive him—while in London the annual depth was only 23 inches, in Keswick it was no less than 60.—Mr. ROBERTS observed, that the discrepancies in the registries of rain-gauges were such as to render great caution necessary in drawing conclusions. It was now beginning to be understood that unless the rain-gauges were placed on a level with the earth, no indication would be obtained from them of the quantity which fell on the surface.—The Astronomer Royal said that there was something still unexplained as to the effect of the altitude at which the rain-gauge was placed, on the amount of rain received; while the quantity of rain received in the gauge on the top of the Observatory was less than that placed in the court below, yet a gauge placed at the foot of Greenwich Hill, which was at a [con]siderably lower level than either, received [les]s rain.—Sir J. HERSCHEL believed that [the] cold drop as it descended from above [rec]eived accessions from the vapour of the [air] through which it passed; and if this be [the] true account, then the explanation was [com]plicated by the relative hygrometric [stat]es and temperatures of the several strata [of] air.

Furnace Gases.

A report was read from Prof. BUNSEN and Dr. LYON PLAYFAIR, "On the Gases from Furnaces." The authors had collected the gases from every part of iron furnaces, in England, Norway, and Sweden. These gases were found to be,

1. Nitrogen.	6. Carbonic acid.
2. Ammonia.	7. Carburetted hydrogen of unknown composition.
3. Light carburetted hydrogen.	8. Aqueous vapour.
4. Olefiant gas.	9. Hydrogen.
5. Carbonic oxide.	10. Sulphuretted hydrogen.

The gasification of coal in the furnaces takes place at two different points, in the first instance during the distillation of the coal and the formation of coke; and secondly, when the coke undergoes the process of combustion. This result was uniformly observed, and the authors verified it by subsequent experiments on artificial arrangements. The analysis of coal by dry distillation gave—

Coke	68·92
Tar	12·23
Water	7·61
Light carb. hydrogen	7·04
Carbonic oxide	1·13
Carbonic acid	1·07
Olefiant gas	0·75
Sulphuretted hydrogen	0·75
Hydrogen	0·50
Ammonia	0·17
Nitrogen	0·03
Condensed hydrocarbon	0·00
	100·00

Voltaic Reduction of Alloys.

A paper on this subject, by Mr. C. V. WALKER, was read. It had for its object to explain the methods by which the author has succeeded in throwing down metallic alloys from compound solutions by the action of galvanic electricity. The process adopted is to prepare a strong solution of cyanide of potassium, and commence electrolyzing it, by means of a copper anode; as soon as copper begins to be dissolved, the copper anode is removed, and its place supplied with one of zink; after the action has continued for some little time, brass will be liberated on the cathode. The solution is now ready for use, and is operated upon by two or three Daniell's cells, and with a brass anode. By similar means alloys of gold and copper, or gold and silver, may be deposited. The author reasons, that true brass is a definite chemical compound; and observes, "It appears possible that the anode, which is a brass of commerce, is a true alloy, plus an excess of zink; that the solution it produces is a

mixed solution, which consists of the potassio-cyanide of brass and the potassio-cyanide of zink. The solution is very readily decomposable; it is therefore necessary to prepare it a short time previously to its use." Many specimens were exhibited of copper and other metals coated with brass. The author makes some remarks on the theory of the action; and concludes by stating that it will be quite possible to determine, within certain limits, the character of the alloy that shall present itself, and that we may be enabled to throw down gold and silver according to standard.

Experiments on the Spheroidal State of Bodies, and its Application to Steam-boilers, and on the Freezing of Water in red-hot Vessels.

A paper under this title, by Professor Boutigny, was read and illustrated by experiments. The Professor commenced by showing that when cold water is poured on a hot metallic surface, the heat is not communicated to it; and that the water assumes a spheroidal form, and continues to roll about, upheld at a minute distance from the heated surface, without boiling. The water poured into a heated platinum cup kept in rapid motion, and resembled a small globe of glass dancing about. There was no hissing noise nor appearance of steam, though the globule of water must, nevertheless, have evaporated rapidly; for, after gradually diminishing in size, in the course of about two minutes it disappeared. The same result takes place when any substance capable of assuming a globular form is placed on a heated surface. In proof of this, the Professor placed in the heated cup of platinum, iodine, ammonia, and some inflammable substances; each of which became globular, and danced about like the globule of water, but without emitting vapour or smell, or being inflamed, until the platinum cup was cooled. Another experiment was yet more curious. Professor Boutigny heated a silver weight, of the same shape as the weight of a clock, until it was red-hot; and then lowered it by a wire into a glass of cold water, without there being the slightest indication of action in the water, more than if the weight had been quite cold. Professor Boutigny advanced no theory to account for these peculiar actions, further than that a film of vapour intervenes between the heated body and the substance, which prevents the communication of heat. The facts, however, he thought were of importance in a practical point of view, both as regards the tempering of metals, and in the explanation of the causes of steam-boiler explosions. It would seem from these experiments, in tempering metals, that if the metal be too much heated, the effect of plunging it into water will be diminished. In steam-boilers also, if the water be introduced into a heated surface, the heat may not be communicated to the water, and the boiler may become red hot, and without any great emission of steam; until at length, when the boiler cools, a vast quantity of steam would become suddenly generated, and the boiler burst. The last and most curious experiment performed by Professor Boutigny was the freezing of water in a red-hot vessel.* Having heated a platinum cup red-hot, he poured into it a small quantity of water, which was kept in a globular form, as in the other experiments. He then poured into the cup some liquid sulphurous acid; when a sudden evaporation ensued, and, on quickly inverting the cup, there came out a small mass of ice. This experiment called forth loud and continued applause. The principle on which this experiment depends is this—sulphurous acid has the property of boiling when it is at a temperature below the freezing point; and when poured into the heated vessel, the suddenness of the evaporation occasions a degree of cold sufficient to freeze water.

DR. W. G. TURNER'S PATENT METHOD OF PURIFYING THE VAPOURS OF CHEMICAL WORKS.

Dr. Turner's patent (dated August 22, 1844, specified February 8, 1845,) is for "*an improved method of directing the passage of, and otherwise dealing with, noxious vapours, and other matters arising from chemical works in certain cases.*"

The nature of this invention consists in the application of certain mechanical contrivances to produce a draught in the manufacture of sulphuric acid, muriatic acid, and sulphate of soda, and to the roasting and smelting of metallic ores, in aid of, or as a substitute for, the ordinary draft of a chimney; by which contrivances, together with certain improved processes, that portion of the acid gases and metallic fumes are condensed, which, in the methods now employed, escape into the atmosphere. Moreover, the products obtained from a certain quantity of materials are stated by this invention to be considerably increased, while the causes of injury to vegetation, &c. are completely removed.

The apparatus by which the object of this patent is effected, consists of a horizontal

* For the first account published in England of this remarkable experiment, see *Mechanics' Magazine*, vol. xli. p. 23.

vessel, which may be of sheet iron, fire-brick, or stone, according to the corrosive or non-corrosive nature of the substances employed therein. In this vessel is placed a continuous screw, made of suitable materials, and revolving on an axis, which is connected with a steam-engine, water-wheel, or other moving power, in such a manner as to cause the screw to revolve with great rapidity, and thereby to produce the requisite draft, the threads or vanes of the screw being made of considerable width for that purpose. Upon the shaft of the screw, and at certain intervals along its length, are placed long arms, projecting perpendicularly from the shaft to distances nearly equal to the thread of the screw. The vessel in which the screw revolves is then connected with the furnace from which the fumes are emitted by means of a flue, and a quantity of water is allowed to enter the vessel by means of a feed-cock, so as to cover the lower edge of the screw to the depth of three or four inches, the lower part of the vessel forming a trough for the water, from which, by means of a suitable tap, it may be abstracted at pleasure. The arrangement being thus effected, the screw is put in motion up to a speed competent to produce the requisite draft in a direction from the furnace; at the same time the water in the vessel is worked by the action of the screw, and violently dashed and broken, by the arms projecting from the shaft, into a mass of foam and spray, which wets the fumes by beating them about with the water in their passage through the vessel, until they become too heavy to pass on with the draft, when they descend to the bottom of the trough. When this apparatus is applied to the condensation of lead, or other metallic fumes, the water must be drawn off from time to time, into proper tanks or receivers, in which, by standing, the metals are deposited.

When this invention is applied to the manufacture of sulphuric acid, the patentee avails himself of the aid of such condensing agents as the acid gases have an affinity for; and in order to this, he employs a series of air-tight vessels, called condensers, which should be made of wood, and lined with lead, and strong enough to bear a considerable pressure. In one of the condensers with which the draft pipe is connected, a quantity of what is usually called chamber acid is admitted, so as to cover the opening of the draft pipe from the sulphuric acid chamber to the depth of two or three feet. The upper part of this condenser is then connected with air-pumps of sufficient power and capacity to draw through 162,000 cubic feet of air for every hundred pounds of sulphur burnt, and to cause a partial vacuum to be made and maintained in the upper part of this condenser. By this arrangement, the gases from the sulphuric acid chamber force their way in a continuous stream through the acid in the condenser, and thus cause a draught from the sulphuric acid chamber.

For the better understanding of this invention, it must particularly be remarked, that there are three causes which operate to produce the loss of nitre in the common method of manufacturing sulphuric acid; which causes of loss are stated to be entirely prevented, or at least greatly diminished, by this improved draft, and mode of dealing with the noxious vapours. The apparatus and processes by which these objects are effected are fully described in the specification; but being too long to admit of a brief and perspicuous analysis without reference to the drawings, we think proper to conclude by merely stating the objects of the claim, which are ranged under five different heads, as follows:—

Firstly, the application of a screw and arms working in water, the one for the purpose of creating and increasing the draft, and the other for wetting and condensing the noxious vapours proceeding from furnaces in which the roasting and smelting of metallic ores are being carried on. Secondly, the application of the screw, or of air-pumps and condensers, in the manufacture of sulphuric acid, muriatic acid, and sulphate of soda. Thirdly, the substitution of nitric acid to the sulphuric acid, in the acid chamber, for nitre in the furnace. Fourthly, the substitution of a shallow sulphuric acid chamber, instead of the deeper one hitherto in use, to prevent the formation of the crystalline compound of sulphuric and hyponitrous acids therein. And fifthly, the working the vapours in, and escaping from the acid chamber, through the condensers, with the condensing media or agents.

FRENCH PATENT LAW CASE.*

Tribunal Correctionel de la Seine, June 6, 1845.

M. Perrot, President.

MM. Christofle and Co. v. *M. Bertrand.*

The plaintiffs have a license to use MM. Elkington and Ruolz's patents for electro-gilding and plating; and have already maintained several actions. The present action occupied the tribunal during four sittings; and is interesting both in respect to the

* For the translation of this Report we are indebted to the last Number of Mr. C. V. Walker's valuable Periodical, *The Electrical Magazine.*

questions which it raises, and to the developments which it has given of the respective pretensions of individuals.

The following are the facts :—

Several seizures were made, at the request of M. Christofle, in the workshops of one Bertrand, a gilder; and a jury of three, MM. Chevalier, Barrel, and Henry, appointed by the magistrate who has this affair in hand, have drawn out a detailed report of the objects seized, and placed it on the rolls of the court. Their opinion is favourable to the patentees.

M. Emanuel Arago opened the case for the plaintiffs, by detailing the affair, and commenting on the report of the jury.

M. Marie, on the part of the defendant, put forth three propositions, and gave evidence in support of them :—

1st. *There was no invention of galvanic gilding, either on the part of Mr. Elkington or of M. de Ruolz; and consequently their patents cannot be regarded as valuable.* In support of which, he cited the chemical labours of Brugnatelli,* and De la Rive,† and a publication by M. Louyet, of Brussels.‡ Brugnatelli and De la Rive had discovered the principle of the new gilding; and this principle, in his opinion, contains the germ of all the ulterior labours of MM. Elkington and De Ruolz, which ought to be considered as simple applications, of a more or less happy kind, but not patentable.

2nd. *Supposing that there was an invention, and that the patents were valid, M. Bertrand cannot be condemned for infringement; for before the patents were taken out, he gilt by the same processes that are now in use; he ought to enjoy the benefit of the anterior possession.* In support of this, M. Marie presented to the Tribunal numerous attestations in proof that, before the patents were taken out, M. Bertrand had gilt objects that could not be gilt by the old process, such as filigrees and solderings of tin; he also put forth invoices proving that, before the patents, M. Bertrand had purchased certain chemical products, and especially the cyanides, the useful application of which to galvanic gilding had afterwards been pointed out by MM. Elkington and De Ruolz. And, according to the learned counsel, M. Bertrand is not the only one who had employed these substances anterior to the patent. M. Perrot, of Rouen, has just published a pamphlet, in which he maintains having gilt with the cyanides before the patents were out.*

3rd. *In the next place, the report of the jury cannot serve as the ground for an immediate solution; and this for several reasons,—first, because it says nothing in a precise manner on the question of novelty, and then, because it is* ex parte; *if it is* ex parte—*if M. Bertrand would not assist the operations of the jury; it is because, in his opinion, the questions were not well put by the magistrate. A second report is therefore necessary; and a fresh jury ought to be named.* He here gave a critical examination of the report, which appeared to him incomplete, and by no means conclusive.

M. Emanuel Arago, in reply, said that he could not comprehend how the discovery of MM. Elkington and De Ruolz could be denied, to whom the Academy of Sciences had awarded two grand Monthyon prizes, upon the report of M. Dumas, as one of a commission, consisting of MM. Thenard, Darcet, Chevreul, Pelouze, and Pelletier. In order that the defence be admissible, we must admit that all these philosophers were ignorant of the labours of De la Rive. Now, this same commission that decreed a prize of 8000 fr. to Mr. Elkington, and another of 8000 fr. to M. De Ruolz, had given M. De la Rive a prize of 4000 fr., in recompense for the discovery of

* Vide *Bibliotheca di Campagna*, &c., vol. x. p. 185—6. Milan, 1807.

† Vide *Annales de Chim. et Phys.*, vol. lxxiii. p. 398. 1840.

‡ Vide *Bulletins de l'Acad. de Bruxelles*, Dec. 4, 1841, vol. viii. p. 448.

* We give the following extracts from M. Perrot's pamphlet, entitled, "*Machine Lithographique-Machine à Imprimer les Etoffes et Dorure Galvanique*," published by Lange, Levy and Co., Paris, 1844.

"1805. Brugnatelli.—The first idea of gilding by the galvanic pile is traced to Brugnatelli. He states his having gilt silver medals with a pile of several elements.†

"1840.—M. De la Rive.—This learned philosopher gilds silver, copper, and brass with chloride of gold, by means of a galvanic apparatus of a single element. The piece to be guilt forms the negative pole of the single element.

"1840, *August*, M. Perrot.—I obtain on gold, silver, copper, and on every oxidizable metals, such as iron and steel, very fine gildings, without the interposition of any metal. Not any of these gildings could hitherto be obtained, except by the employment of the battery and the alkaline cyanides.

"1840, *September*. Mr. Elkington.—He demands a further patent (*brevet d'addition*, Fr.) in which he appropriates M. De la Rive's process. But, instead of dissolving the gold in chlorine, he uses prussiate of potash (alkaline cyanides); and he replaces the bladder used by M. De la Rive by porous earth, as has been long the practice in electrotype.

"1840, *December* 15. M. De Ruolz.—He proposes to cover silver objects with a film of copper, so as to render them fit to be gilt by M. De la Rive's process."

† "To one part of the saturated solution of gold in nitro-muriatic acid, add six parts of solution of ammonia, by which the solution is decomposed, and oxide of gold is precipitated, and a portion is set free, forming ammoniuret of gold."—Brugnatelli's gilding solution, extracted by *Editor Elec. Mag.*, from Zantedeschi's Elecricity, vol. ii. p. 468.

a scientific principle—a scientific principle inapplicable, as they explain in their report, to the actual art of gilding; whilst, in the processes of MM. Elkington and Ruolz, they find all the conditions of a good applicable gilding—a marketable gilding by electricity—a gilding that was impossible before their processes.

M. E. Arago, in support of his assertion, cited several passages from the report of the Academy of Sciences, proving that the liquids described by MM. Elkington and De Ruolz, cover objects to be gilt with a continuous and perfectly adhering layer of gold, without in any way attacking and corroding the objects; whilst M. De la Rive's liquor reacts on the objects, attacks them, and cannot cover them with that adhesive and continuous layer of gold which is alone acceptable in commerce. He further added, that if De la Rive and Brugnatelli did produce good gildings, let M. Bertrand adopt their processes, and the patentees would not in any way interfere with his operations. With respect to the anterior possessions, the learned counsel canvassed the specimens produced by M. Marie, which did not appear to him in any way decisive. With regard to M. Perrot, he appears in exactly the same position as M. Bertrand; but, even supposing he were right, this would have no bearing on M. Bertrand; for if M. Perrot had shown his gildings before the patents, he had never told, had never published how he had obtained them. M. Arago concluded by repelling the demand for a fresh jury.

After a fresh reply from M. Marie, the King's Counsel, Camusat Busseroles, gave his opinion in favour of M. Christofle :—

"The Tribunal, &c., as concerns Cloménil,—inasmuch as there is no proof that he acted otherwise than as workman to Bertrand, executing the orders of his patron, dismiss him without expenses. As concerns Bertrand,—and first, with respect to the demand for a new jury to report also on the process claimed by Bertrand; inasmuch as Bertrand's process, so far as it constitutes a personal and distinct discovery, is not in question; inasmuch, on the other hand, as there does not appear any legitimate motive for recommencing the investigation that was made, as it is regular, and contains sufficient elements, when joined to the other specimens and documents of the process, to throw light upon the decision that is to be given; and mainly, inasmuch as it follows from the debates, the specimens and the documents produced, that the preparations seized at Bertrand's are conformable to those, for which the prosecutors or their authorities have obtained some of their patents; that Bertrand maintains that these patented preparations have not the character of true inventions; that he also opposes the exception of forfeiture, and in all cases anterior possession.

"But in respect to the question of invention,—inasmuch as, in the matter of discoveries, not only are the principles susceptible of being patented; that their consequences, their divers applications and combinations, may also constitute new ideas and found privative rights; that, if it is true that the cyanides of gold were for a long time in science, as well as was the galvanic pile, the efficacious application of these cyanides to gilding and plating metals, in a manner, moreover, such as to endow society with a new and so valuable a branch of industry, assuredly merits the title of invention. In respect to the exception of nullity or forfeiture,—inasmuch as the rule is, that a patent is worth nothing, if the discovery, invention, or application is not new; that is to say, if, anteriorly to the date of the deposit of the demand, it has received in France or abroad a sufficient publicity to be executed; but, in fact, inasmuch as it is true that the chemists Brugnatelli and De la Rive had opened the career, their labours, which were curious and interesting in a scientific point of view, were as yet, to speak truly, but simple trials; that it follows from all the documents of the process, that before Ruolz and Elkington, gilding and plating, by aid of the galvanic pile, had remained in such a state of imperfection that the arts and commerce could not gain any thing from them, and that it was the cyanides of these latter, their preparations and combinations, which raised the discovery from its sterility, in order to extend it by a new discovery into the industrial arts; whence it follows that there is in very truth a novelty in their particular invention. As concerning anterior possession,—inasmuch as, rightfully, this means is purely personal; that we cannot invoke the possession of another; inasmuch as, therefore, Bertrand cannot create a title to the possession of MM. Perrot of Rouen, and Louyet of Brussels, if such exists; and moreover, as nothing proves that these two philosophers were in possession of the means of MM. Ruolz and Elkington before their demand for the delivery of patents; further, that nothing establishes their having spread them abroad, either by printed writings or otherwise, so as to attain the degree of publicity necessary to their being henceforth considered as new; finally, inasmuch as, with respect to Bertrand, he by no means justifies his personal possession; that the productions which he makes with this intent are utterly insufficient. That it follows from all which precedes, that there is truly a patentable invention in the processes of Ruolz and Elkington; a new invention without anterior possession on the part of a third individual, to wit, Bertrand; that thus he has rendered himself guilty of the crime of infringement, provided against and punished by the articles 40 and 49 of the Law of July 5, 1844:

"For these reasons, without delaying or having regard to the demand for a new investigation, nor to the exception of the defence, which are rejected as being badly founded;

"Condemns Bertrand to a fine of 300 fr., pronounces confiscation of the preparations and objects seized; orders that they be handed over to Christofle and Co.;

"And, inasmuch as it has been established, that the latter have suffered prejudice from the deed of the aforesaid Bertrand, that reparation is due to them, and that the Tribunal is prepared to appreciate the value;

"Condemns the aforesaid Bertrand to pay to Christofle and Co. the sum of 3,000 fr. as costs and damages; and

"Condems him to the expenses;

"Fixes to one year the duration of the writ of arrest."—From *Le Droit*, June 7, 1845.

DR. RITTERBANDT'S METHOD OF PREVENTING INCRUSTATIONS IN BOILERS.

We are glad to observe from the following account, given in the *Morning Herald*, of a lecture delivered on Monday last, at the Polytechnic Institution, by Dr. Ryan, that the learned professor fully concurs in the favourable opinion which we have expressed

of Dr. Ritterbandt's new process for preventing incrustations in boilers. It is undoubtedly the most scientific and effectual which has been yet devised.

"Dr. Ryan commenced by referring to the importance of any inquiry which would tend to inform the mind of the existence of a great evil, and for which, when known, a remedy could be provided. He then explained the chemical constitution of the deposits from fresh and sea water. The first, we understood him to say, was principally carbonate of lime, formed by the decomposition of the bicarbonate, by heat; and the latter, carbonate of lime, with certain proportions of chloride of sodium, and other saline matter.

"The lecturer then proceeded to illustrate the way in which incrustations injured boilers, and after speaking of its being a cause of increased expenditure of fuel, he proved that as it was a non-conductor of heat, the boiler thus coated would become burnt as if empty, and thus in time be so weakened as to give way under the pressure of the steam. He also quoted authorities to prove, that as most explosions take place after the boiler has been at rest, and after the matter has had time to subside, as on a Monday morning for instance, so in the majority of cases the foulness of the boiler has been the principal cause of the accident.

"In the latter part of the lecture, Dr. Ryan, after referring to the many attempts to prevent this deposition taking place, but hitherto in vain, introduced to his audience a method invented by Dr. Ritterbandt, a scientific foreigner, but who has resided many years in England. This method, to use the professor's words, 'is one based on true philosophical principles, and has therefore been carried out with great success.' We were much pleased with the illustrations Dr. Ryan gave us of the efficacy of the process, which consists merely in converting all the carbonate of lime into chloride of calcium, by the introduction into a boiler of a small quantity of chloride of ammonium. In this way the lime, remaining constantly in solution, the boiler cannot foul, and fuel is saved to a great extent. Nor is this the case merely with fresh water. Dr. Ritterbandt's experiments prove that when sea water is boiled the first change is the liberation of carbonate of lime, the excess of carbonic acid being driven off by heat, and that the particles of that compound become nuclei for the adhesion of the crystals of common salt, &c. which begin rapidly to form in consequence. He also observed that by preventing the formation of carbonate, by the addition of chloride of ammonium, he obviated the chemical effects of contact, and that no salt would deposit until the water became almost evaporated. As this will do away with the necessity of blowing off so very frequently, and will supersede the brine pumps, both attended with an excessive loss of heat and waste of fuel, every one must see the vast advantages which Dr. Ritterbandt has conferred on the scientific world by his experiments.

"Nor must we forget the benefit he confers on his fellow-creatures in thus wiping out from the list of the causes of explosion the most common of all. The inventor, we see, has secured his interests by a patent. We know he will reap a rich pecuniary harvest, and he deserves it."

Mr. Beningfield's "Electric Gun."—Some very interesting experiments have been exhibited in a large plot of ground on the south side of King-street, Westminster, with an electric gun, the invention of Mr. Beningfield, of Jersey, which was noticed in our Journal of the 8th March last. The gun, a barrel for discharging bullets or balls five-eighths of an inch in diameter, is placed over the body of the machine by which the propelling power is generated, and the whole runs upon a carriage with a pair of wheels, weighing altogether half a ton, and calculated to be drawn by one horse at the rate of eight or ten miles an hour: when in position, a third wheel is attached, by which it traverses with ease and steadiness. The engineer is enabled to take a true aim the barrel having a sight similar to a rifle. The barrel is supplied with balls by two chambers, one fixed and the other moveable. This last may be made large enough to contain an immense number of balls. It is calculated that 1,000 balls or more can be discharged a minute, the volleys being shot off in almost continuous or constant succession, the stationary chamber supplying the barrel. The experiments fully carried out all that the inventor professed to do. The bullets were driven through a thick plank, and afterwards completely flattened on an iron target. Those directed against the target without the intervention of the planking were literally beaten to atoms, and in a manner plastered upon boards placed on the sides of the target, which received the fragments as they flew off at angles from the iron. The force far exceeded what can be produced by any military engine of equal calibre in which gunpowder is employed as the propelling power. A three-inch board, at 20 yards distance, was completely shattered through with the bullets, as if the centrebit and drill of a carpenter had been employed; and the rapidity and precision of aim were extraordinary. For clearing a breach or sweeping a force such an engine must be most tremendously destructive. The cost of keeping this gun in repair, and of using it, is stated to be very much beneath the cost which must be employed to bring into operation any other equally efficacious mode of discharging thousands of balls. The invention is not secured by patent, and therefore the inventor did not communicate the secret of the construction of his instrument, or the nature of the power employed. It was avowed, however, that the propelling power is produced, not by steam, but by the application of gases exploded by galvanic electricity.

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No 166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1144.] SATURDAY, JULY 12, 1845. [Price 3*d*.

Edited by J. C. Robertson, No. 166, Fleet-street.

BOSWELL AND RICKETS' REGISTERED FIRE-KINDLER AND SMOKE-ELEVATOR.

Fig. 1.

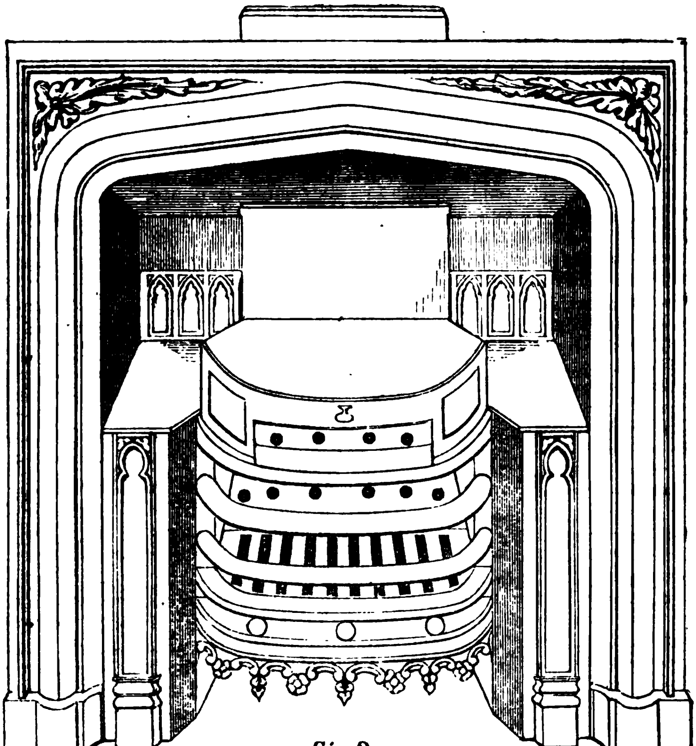
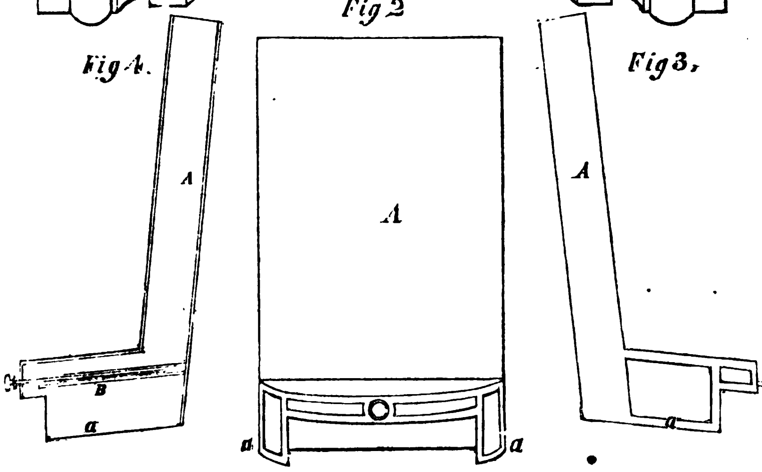


Fig 2

Fig 4.

Fig 3.



BOSWELL AND RICKETS' REGISTERED FIRE-KINDLER AND SMOKE-ELEVATOR.

[Registered under the Act for Protection of Articles of Utility.—G. Boswell, of Harrow, ironmonger, and C. Rickets, of Agar-street, London, gas apparatus manufacturer, proprietors.]

However fire-places may vary in construction, or however superior one sort may be to another, there is none so perfect but that it may be the better of a little help at the outset, towards the kindling of the fire, or the creation of the required draught in the chimney. From time immemorial the hand bellows and drop-plate have been in common use for this purpose; and having survived such an infinity of changes in stove-mongery as they have done, it is not on slight grounds that we would venture to hint that their days may possibly be at last numbered. Certainly, however, we have now before us a contrivance which is better than either; equally portable; much more convenient and efficient; and but little, if at all, more expensive (taking durability into account).

Fig. 1 represents this new apparatus as applied to a register stove of one of Mr. Rickets' most approved forms. Figs. 2, 3, and 4 are detached views of it; fig. 2, being a front elevation, fig. 3, a side elevation, and fig. 4, a vertical section.

The upright hollow piece A is passed up the chimney, through the back of the stove, when it is of the register kind; and when it is not of the register kind, through an iron plate made to close the throat of the chimney. At bottom it rests, by the return ends *a a*, on the top front bar of the stove; or, where there are hobs, partly on the hobs, and partly on the top front bar. B is a sliding plate, by means of which the apertures into the chimney can be diminished or increased to any degree required.

The apparatus may be either applied occasionally only, or allowed to remain as a permanent appendage to the stove.

THE ARTS OF WAR, ARTS OF PEACE—CASE OF CAPTAIN WARNER.

Sir,—In the letter of Captain Warner in the *Times* of August, 1844, copied in No. 1102 of your Magazine, he offers to destroy a ship of the line at five miles distance, *by employing a projectile*, and is willing to take on board with him four witnesses who may bear testimony that he does employ such projectile. Now as this is offered to be done without putting the government to any expense, and I have been verbally informed the Captain has even been so liberal as to leave the amount of reward to the discretion of Sir Robert Peel, it does seem rather strange that the experiment has not been tried ere this; it has not even been mentioned in parliament during the present session that I am aware of. Is there a disinclination to afford the means of testing an alleged power which might render our present expensive naval and military establishments unnecessary? Or is there a mistaken horror of the employment of means, which from their enormous destructive power would render wars of so short duration? If the latter be the cause, we should do well to remember, that every improvement in the science of warfare has rendered it less cruel, and perhaps it is not too much to anticipate that the demonstration of such a power as Captain Warner boasts, would put an end to, or rather prevent the commencement of wars entirely. If so, perhaps Mr. Hume, who has already moved and unanimously carried a deserved pension to one pacificator (Pottinger) might be "economically" employed in proposing another pension to Captain Warner, and in support of his motion might calculate the entire annual saving in the army and navy estimates, which the adoption of the Captain's inventions would effect. Nay, we might afford to do more than this, and create a new title of honour for him, say, "Universal Constable or Keeper of Peace to all Nations," a title which may one day be estimated as highly as that of "Warrior," when value in use becomes the measure of value in exchange, as Adam Smith would say. Seriously, there is a great want of facilities for introducing inventions and improvements into the public service. The case of Captain Warner is only the case of hundreds, some of whom have lived to see their own inventions adopted by Government, with other names associated with them, many years after the inventors' applications have been rejected. One would think that the people and Government were determined to discourage inventors. They certainly take the most effectual means to do so, namely, pecuniary obstacles and neglect. In witness, I may

instance the totally unnecessary expenses of patents, and even when this obstacle is overcome and inventions assume a working shape, not one in a thousand of the "intelligent public" but seems to estimate a new invention much as Nathanael did Nazareth, and can hardly be persuaded to "come and see" if any good has come out of it.

With regard to the long range which the unreflecting have associated with the *long bow*, there is nothing very difficult to effect, except to *hit the mark*. To send a cannon ball or shell far enough only requires powder enough, and a gun strong enough. Even if the atmospheric resistance increases at high velocities, so much as to prevent the practical employment of shells for great distances, we have only to put a tail to our shell, or in other words, convert it into a rocket. If it were inconvenient to make a rocket long enough to carry itself the whole distance required, it might be projected from a gun which would send it two or three miles towards its destination, and it would carry itself the remainder of its range. Perhaps it would not be very difficult to send it the first part of its journey without igniting its own propelling charge; could we do so it might be made yet shorter. A fuse might be attached which would ignite it when it had travelled the two or three miles which the gun forwards it; and if one fuse failed, two or three might be used to insure the ignition of the propelling charge; but this would hardly be needful, as our mortar practice shows that shells with only one fuse rarely fail to burst.

I think I have shown pretty clearly, that a "long range" is a matter of no great difficulty. Indeed a five miles' range is hardly deserving that term; it sinks into insignificance compared with the really long range of Perkins' steam rocket, which was to carry the mail from Dover to Calais twenty years ago, thereby rendering less needful Mr. Fairburn's re modern proposal of an embankment l railway across Dover Straits; or e yet more modern plan of a sub-ma- e railway and tunnel between France l England,—the latter due, I believe, some of the "Bubble Family." Thus the arts of peace exceed those of war, —

reat things have been, and are, and greater still
Want little of mere mortals but the will"—

although the engineering difficulties of the last two projects may be estimated as "pretty considerable."

I remain, Mr. Editor, yours most respectfully,

ALFRED SAVAGE,
Steeled Mill-maker and Machinist.

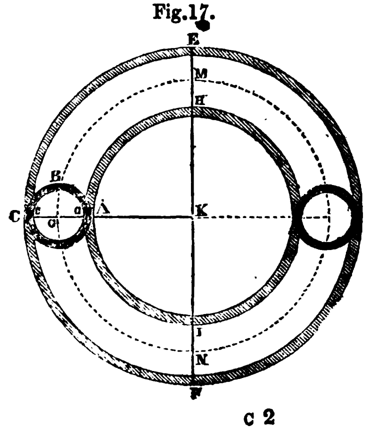
43, Eastcheap, July 5, 1845.

P. S. Since the above was written, I perceive, by yours of this day (July 5), that your old correspondent, Mr. Beningfield, has been discharging a thousand balls per minute by electricity, instead of steam, as Perkins did. I hope he will be able to render it easy of application, and I may venture to predict, that if war ceases not from the pressure (of opinion) from without, it soon will from the pressure of destructiveness within. All such inventors are practically most active Members of the Society for Promoting Universal Peace.

CENTROBARIC MENSURATION. NO. IX.

If the circular plane A B C, fig. 17, instead of revolving about a tangent to the diameter in the point A, be made to revolve about the straight line E F, which is parallel to the tangent, and in the same plane with it; the circle will, by its revolution about E F, which remains fixed, and at the distance of A K from it, generate a solid cylindrical ring, of which the transverse section through the centre and through its two branches are indicated by the dark-shaded circles, while the horizontal section through the axis of the ring is indicated by the annulus of a lighter shade, contained between the circular boundaries C E F and A H I.

Fig. 17.



Now, in this case, as in the preceding, the centre of gravity of the generating plane, A B C, is the same as the centre of magnitude; consequently, K G is the radius of the circle described by the point G, while the circle A B C revolves about E F at the distance A K, and G M N is the path of the point G. But the centre of gravity of the circumference of the generating circle and that of its area, are in the same point; consequently, the convex surface of the ring, and its solidity, are to each other, as the circumference of the generating circle is to its area, (admitting the propriety of comparing these magnitudes,) because, according to our principle, the surface of the ring is equal to the circumference of its transverse section, drawn into the circumference of the circle described by its centre of gravity, and the solidity is expressed by the area of the transverse section, drawn into the same quantity, viz.: the circumference of the circle described by the centre of gravity of the generating plane.

Let A K, the nearest distance of the revolving circle from E F, be denoted by d, and A G by r, as before; then we have K $G=(d+r)$, the radius of the circle described by the point G; consequently, we have G M N $2\pi(d+r)$, the circumference of the circle whose radius is K G. But the circumference of the circle A B C, whose radius A $G=r$, is $2\pi r$; hence by our general principle, we get $2\pi(d+r)\times 2\pi r=4\pi^2 r(d+r)$, for the surface of the cylindrical ring; which expression reduced to its numerical value, becomes $39{\cdot}4784\times r(d+r)$, from which we derive the following practical rule:—

To the inner radius of the ring add half its thickness, multiply the sum by the said half thickness, &c., again by the co-efficient 39·4784, *and the product will be the convex surface required.*

This rule, it will be observed, is not expressed in the same terms as that which is usually given for calculating the convex surface of a cylindrical ring; but the expression $4\pi^2 r(d+r)$ can be so modified as to supply the identical rule; thus we have $4\pi^2 r(d+r)=2\pi^2 r(2d+2r)$. Now $2d$ is the inner diameter of the ring, and $2r$ is its thickness, and the numerical value of π^2, is 9·8696; hence the rule is:—

To the inner diameter of the ring add its thickness; multiply the sum by the thickness, and again, by the constant co-efficient 9·8696, *and the product will be the surface sought.*

Which is the rule for calculating the convex superficies of a cylindrical ring, as usually given in the common books on mensuration.

Again, for the solidity, we have the area of the generating plane A B C, expressed by πr^2, and it has been shown above, that the circumference of the circle described by the point G, is G M N $=2\pi(d+r)$; therefore, by multiplication, we have

$$2\pi^2 r^2(d+r)=\pi^2 r^2(2d+2r)=9{\cdot}8696\times r^2(2d+2r,)$$

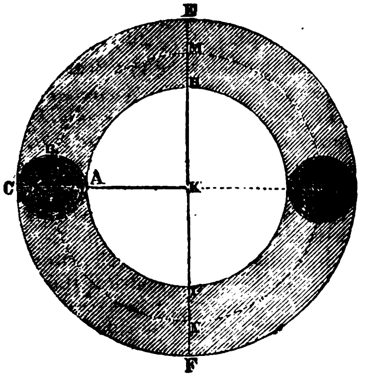
an expression for the solidity, and from which we deduce the following practical rule:—

To the thickness of the ring add its inner diameter; multiply the sum by the square of half the thickness, and again, by the constant co-efficient 9·8696, *and the product will be the required solidity.*

If we compare the analytical expressions for the surface and solidity of the ring, we shall find them to bear to each other, the relation of $2\pi^2 r(2d+2r)$ to $\pi^2 r^2(2d+2r)$, and if the common quantities be eliminated or expunged from these terms, the relation is simply as 2 to r. Hence it appears, that when half the thickness of the ring is less than 2, the surface is greater than the solidity; when half the thickness is equal to 2, the surface and solidity are equal between themselves; that is, the surface in square measure is expressed by the same number or quantity as the solidity in cubic measure; but when half the thickness is greater than 2, the number or quantity representing the solidity is greater than that which expresses or represents the superficies.

If the annulus A B C, fig. 18, be ma[illegible] to revolve about the straight line E F, [illegible] the same plane with it, and distant [illegible] the length of the perpendicular K G, [illegible] will generate a hollow ring or cylindric[illegible] tube, of which the transverse secti[illegible] across the centre and both its branche[illegible], is represented by the two equal dark-sha[illegible]ed annuli; whilst the horizontal secti[illegible]

Fig. 18.



through the axis of the tube is represented by the two unequal and light-shaded annuli C E F and A H I. It is evident from the nature of the figure, that the centre of gravity of the annulus A B C is in the same point with the centre of magnitude of its bounding circles; consequently, K G is the radius of the circle described by the revolution of the point G, and G M N is the corresponding circumference. Put A K $=d$, A G $=r$, and let $t=$ the thickness of metal or the width of the revolving annulus; then is K G $=(d+r)$ A C $=2r$, and the inner diameter of the generating annulus, is therefore equal $2r-2t$; that is, $a\,c=2\,(r-t)$. Now, according to our general principle, the solidity of the figure generated by the revolution of the annulus A B C is equal to the solidity of a prism, whose base is the area of the annulus, and altitude the circumference of the circle described by the centre of gravity; but the area of the generating annulus is $\pi.t\ (2r-t)$, and the circumference G M N, is $2\pi\,(d+r)$; the solidity of the material constituting the cylindrical ring or tube is, therefore,

$$2\pi\,(d+r)\times\pi t\,(2r-t)=2\pi^2 t\,(2r-t)\,(d+r),$$

and the expression which supplies the following practical rule:—

From the exterior or greater diameter of the revolving annulus, subtract its width or the thickness of metal which it contains; multiply the difference by the said thickness of metal, and again, by the inner diameter of the ring added to the greater diameter of the generating annulus; then multiply this product by the constant coefficient 9·8696, *and the result will be the solidity sought.*

The same thing may be accomplished otherwise, as will readily appear; for if we calculate the solidity of two solid rings whose diameters are A C and *a c* respectively, and distances A K and *a k*, the difference will manifestly be the solidity of the cylindrical tube, and the form of the resulting expression would be precisely the same as that obtained above.

PREVENTION OF INCRUSTATION IN BOILERS—DR. RITTERBANDT'S PROCESS—MR. JOHNSTON'S PATENT BOILERS.

Sir,—From your remarking on Dr. Ritterbandt's patent, "this has every appearance of being an eminently useful invention, we have never before seen the great evil which it is intended to obviate, grappled with in so scientific and effectual a manner," you are evidently predisposed in favour of his invention; yet, from the impartiality you have displayed towards all controversial writings which I have perused in your Magazine for a series of years, I am satisfied that you will find room for the insertion of the following remarks on boiler incrustation.

Scientific men have long laboured under the delusion that the deposits in boilers are insoluble, owing to their being chiefly composed of sulphate of lime.

I am much gratified to find that Dr. Ritterbandt and others are now convinced that it is "*the heat employed to generate steam* causing the lime which exists in the water, in the form of *soluble bicarbonate of lime*, to be converted into an *insoluble carbonate of lime;* and (that) in marine boilers, incrustation is generally promoted by the carbonate of lime set free *by the heat*, which, as it floats in the water previous to subsidence, forms nuclei for the accrescence of other matter, and disposes the saline compounds, such as the sulphate of magnesia, chloride of sodium, *to crystallize and precipi-*

tate much sooner than they otherwise would."

These are Dr. Ritterbandt's own words, and he is perfectly right in the opinion conveyed by them, viz., that it is heat which causes the salts, both in marine and land boilers to pass from the soluble to the insoluble state.

The Doctor admits, or rather declares, that the heat is the grand cause of the disease; and, in order to alleviate it, he puts into the boiler a quantity of ammoniacal salt. Now in this treatment of the patient I do not agree. Instead of attempting to alleviate, I have succeeded in removing the cause—*the heat.*

The temperature to which water is raised in the act of being converted into steam in a boiler is not sufficient to cause the salts to pass from the soluble to the insoluble state. This change is produced by the *over*-heated state of the metal of the common kinds of boilers; an over-heating which is not at all a necessary accompaniment of the converting of water into steam by the application of fire to a boiler.

The existence of minute globules of steam on the metal of boilers is the cause of its becoming over-heated. By constructing boilers so that currents of water are formed in them, which sweep along the heating surface, and remove from it the globules of steam the instant they are formed, the metal of the boilers never becomes hotter than the water it confines; and consequently, the salts in a boiler thus constructed can nowhere receive that amount of heat which is necessary to make them pass from the soluble to the insoluble state.

I have had a seven-horse power boiler constructed according to this plan, working for the last thirteen months; a portion of that time it was worked with sea-water, and the remaining time with fresh water, which naturally contains a large quantity of lime; yet no deposit has ever formed within the boiler.

The fact, that the red-lead paint with which the interior of the furnace and flues were painted thirteen months ago, is still in good condition, is a most convincing proof that the metal never exceeds in temperature the water which it confines.

The subjoined accounts of some experiments on this subject would, I think, be new and interesting to some of your readers, if you can find room for them.

I remain, yours truly,

JAMES JOHNSTON.

Willow Park, Greenock,
July 3, 1845.

Experiments.

Experiment First. Put fifty cubic inches of sea water into a vessel, and place it in a water bath over a fire; the temperature of the vessel containing the sea water can never exceed 212° Fahr., as the intervening water of the bath prevents it. After the bulk of the water has been diminished by evaporation until there is only ten cubic inches of water remaining, then allow it to cool, and it will be found that no crystals or hard deposit of any kind has been formed: a considerable quantity of a soft flocculent substance will have settled to the bottom of the vessel; but the slightest motion of the vessel causes it to move about, and on again applying heat to the vessel the flocculent matter rises up and is dispersed throughout the water. Let the evaporation now be carried on until there be between seven and eight cubic inches of water remaining, and then allow it to cool; it will now be evident, by the existence of a few small crystals, that the water is a saturated solution.

This experiment proves that no hard or injurious deposit will be formed in a vessel in which sea water is evaporated, until the water has become a saturated solution, provided the vessel containing the water be not heated beyond 212° Fahr.

Experiment Second. Place other fifty cubic inches of the same sea water in a Florence flask over a gas light for evaporation; after the water has become thoroughly heated it will assume a milky white appearance, and immediately after the flocculent matter will become visible throughout the water, the same as in the first experiment. Continue the boiling of the water until there is about nineteen cubic inches remaining; if the bottom of the flask be now carefully watched, small specks of a hard scaly deposit will be observed forming; count their number, observe their size, and allow the flask with the water to cool; when cold it will be evident that no increase has taken place in the quantity of the hard deposit, but the soft floccule[nt] matter will have settled down on the botto[m] of the flask. The specific gravity of th[e] water will now be 1070, and it will float on [one] of Twaddell's hydrometers to the 14°. Ap[ply] the flame of the gas again to the botto[m] of the flask; all the flocculent matter wi[ll] immediately rise up from the bottom and [be] dispersed throughout the water, without a[n]

increase being made to the scaly deposit previous to the water having commenced to boil; but as soon as ebullition has fairly commenced, then the scaly deposit will begin to increase and go on as it did at first.

Now this experiment shows that scaly deposit is only formed during the time the water is boiling, and where the ebullition is greatest.

There is another fact connected with this experiment which I must make known. If the hard deposit was formed in consequence of the water being saturated with matter, it is reasonable to suppose that the deposit would fall to the bottom in a circular or round shape, as the bottom of the flask is spherical, but this is not the shape that it assumes. The gas flame which I used was what is called a swallow-tailed burner; the top surface of the flame next the flask is a flat narrow strip, and, what is very remarkable, this hard deposit inside the flask is formed in the shape of a narrow strip crossing the bottom of it, and exactly coinciding with the flame outside. From this it is evident that the hard scale is formed in consequence of the overheating of the part of the flask acted on by the flame.

* * * * * *

When the salt water comes in contact with the over-heated plates, they produce or cause a premature crystallization. The process is a production of salt from water which is not saturated.

Can any other circumstance connected with the working of boilers but the overheating of the plates be assigned as the reason why the water in marine boilers deposits salt, although it is not a saturated solution?

After a little reflection on these observations, the following question is likely to be suggested, and I shall therefore answer it.

As the salt is produced from water that is not saturated, by the over-heating of the plates; why does the salt not re-dissolve after the producing cause has been removed, by the boiler being allowed to cool?

Now the fact is, that salt thus produced does re-dissolve into the water from which it was taken, provided another change be not allowed to take place; for after that change it is insoluble even in fresh water.

I frequently repeated the second experiment, and in all my trials of it but one, I found that the scale of salt formed, gradually dissolved in the course of twelve hours after the boiling ceased. The trial in which the scale did not re-dissolve at first excited my curiosity, but I soon found out the cause. The person that I sent for the sea-water on this occasion brought it in a rusty iron vessel, and the water had absorbed a considerable quantity of the oxide of iron from it. When the water was boiled, the oxide of iron united with the scale, and formed an insoluble compound. In the other trials pure sea-water was used, and it could receive no oxide of iron from the vessel in which it was boiled, as it was a glass flask; therefore in those repetitions of the experiment the scale dissolved when the water cooled.

Marine boilers are themselves the source whence the scale receives the metallic oxide, and becomes an insoluble compound.

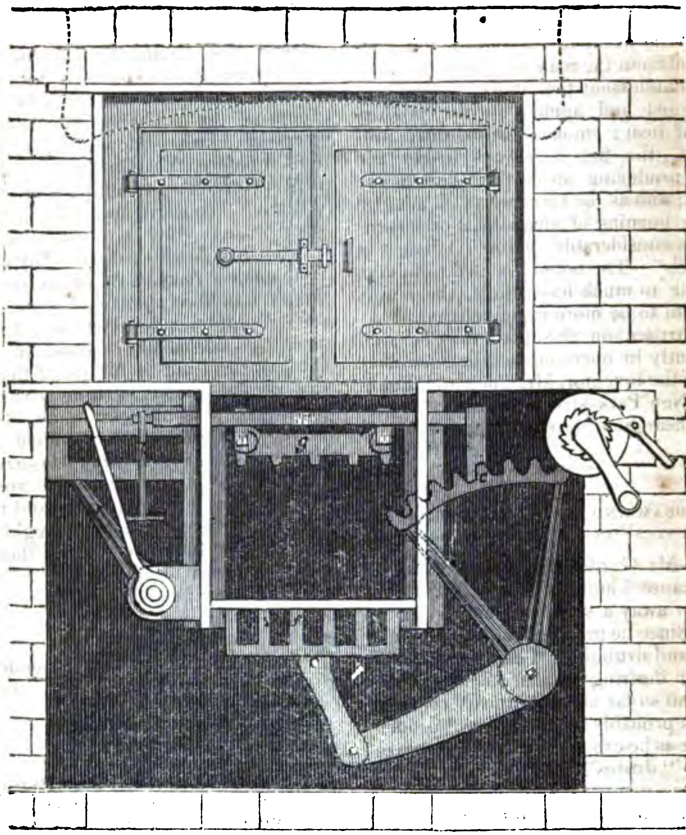
In making the above experiments, I observed that the coating of deposit, after being formed, did not continue to increase in thickness so rapidly as I supposed it would, judging by the rapid manner in which the first coating was formed, and the reason why it did not do so, is owing to the first coating being attached to a firm substance (the glass); whereas the succeeding coatings required to attach themselves to the first coating, a substance which was, comparatively speaking, soft, and from which it was easy for the bursting bubbles of steam to detach portions of the newly-formed scale.

On carrying on the experiments for a length of time, I found that there was a considerable quantity of those detached portions of scale moving about in the water. Now I think it will be admitted, that the same circumstances will occur in marine boilers: viz. that when scale has been and is continuing to be formed in a marine boiler, there will always be suspended in the water minute portions of detached newly-formed scale, and as you are aware that this scale has an affinity for iron, the only conclusion that can be drawn is, that those portions of scale are carried by the ebullition of the water to the comparatively speaking quiescent side parts of the boiler, where they have undisturbed freedom to satiate themselves with their favourite, the iron composing the shell, with which they soon become united in the form of a hard crust.

From a careful inspection of the two kinds of scale, it is evident that scale from the flues of a marine boiler is of a hard crystalline nature, whereas that from the shell is of a soft, chalky structure,—facts which corroborate my experiments and theory.

I now consider it an established fact, that the premature crystallization in marine boilers, from water which is not saturated with salt, is caused by the local action of the overheated plates on the water which comes in contact with the plates immediately after each bubble of steam has detached itself from the plates.

COUPLAND'S PATENT BOILER FURNACE FOR THE PREVENTION OF SMOKE AND SAVING OF FUEL.



The present furnace is introduced to the public as being "at once simple and effective for the prevention of smoke and saving of fuel; and alike adapted for the boilers of land and marine engines, and for all purposes where a furnace is employed."

It is constructed on the principle of lowering at pleasure and in a horizontal position, a portion of the fire-bars to a position sufficiently below the fire to enable a fresh supply of fuel to be placed thereon, and then raising them again to their former position, and retaining them there, till the fuel is consumed and a fresh supply required, and all this without interfering with the draught necessary for the combustion of the fuel while being so consumed. The means by which this is effected will be readily understood from an inspection of the accompanying figure. The bars *g*, are lowered to a level with the grating *f*, when a supply of fuel is required. When the fuel is supplied, the whole is raised by the handle *a*; whereupon the grating *f* is lowered, and the bars *g* are retained in their original position. If, on lowering the bars *g* the

fuel thereon be not sufficiently coked, or the space be too wide to allow it to retain its position, bars or plates *k* are thrown across in order to afford a temporary support.

By these arrangements we are assured, that "the whole of the carbon and gases emitted from the coals are passed through the incandescent fuel above, and thereby consumed and applied in the production of heat; smoke is altogether prevented, the fire is always bright and clear, producing an uniform heat to the boiler; and as the furnace is well adapted to the burning of small coals or screenings, a considerable saving is effected in the fuel." The boiler is stated to be also "liable to much less injury, the supply of steam to be more rapid and regular."

A furnace on this plan may be seen constantly in operation at the manufactory of the inventor, Mr. Coupland, Pond-yard, New Park-street, Bankside, Southwark, near Southwark Bridge.

SWAY-BEAM AND DIRECT-ACTION ENGINES —"JUSTUS" IN REPLY TO MR. GORDON.

Sir,—Mr. Gordon declines a contest with me because I am anonymous. He wont "throw away a shot at a shadow"! So be it. Since he prefers submitting quietly to a sound drubbing, I can have no motive for desiring to alter his determination; and so far as he is himself concerned it is probably as discreet and prudent a course as he can take. Surely, however, he doth "Justus" some wrong in flouting at him as a mere "shadow." Shadows do not ordinarily manifest so much flesh and blood. A person may be anonymous, and yet no ghost. A knight may fight with his visor down, and yet have strength enough in his arm to smite an opponent to the dust. Calling "Justus" names, will not make his blows fewer or lighter than they actually are. Turning tail will not turn right into wrong. To speak in (perhaps) plainer terms, it will not make the charges which I have brought against Mr. Gordon, either truer or falser, that they have not the actual name of the writer attached to them. And if true (as most impartial persons will probably deem them to be, till the reverse is shown), Mr. Gordon may depend upon it, that anonymous though they be, *they will stick.* Considering these things, methinks, that if Mr. Gordon *could* have refuted what I have urged against him, he would have better consulted his own reputation by doing so at once, than by stickling for the name of his accuser before he enters on his defence. What ought it be to him—compared with the prompt vindication of his character for upright and fair dealing—whether it be "John Johnson" or "Thomas Thomson" that accuseth him? However, as I have hinted before, Mr. Gordon's vindication is Mr. Gordon's own affair, none of mine. All that it concerns me to do, is to keep your readers duly reminded, that Mr. Gordon's refusal to discuss my charges is *no answer to them.* For the *incognito* which I think it right to observe, I need not, I apprehend, offer any apology, after the satisfactory manner in which the propriety and usefulness of the practice of anonymous writing (where no point of personal testimony is involved) has been so often upheld by the Editor of the *Mechanics' Magazine* in the pages of his journal. To yourself, at least, I am not unknown; and to Mr. Gordon, as to all others, it ought to be enough that you have thought there was gravity enough in my charges, to entitle them to a fair hearing and thorough investigation.

I am, Sir,

Your obliged correspondent,

JUSTUS.

July 5, 1845.

CONTRIBUTIONS TOWARDS A HISTORY OF INVENTIONS, OR MEMORANDA COLLECTED CHIEFLY FROM OBSOLETE AUTHORS.

[From the *Franklin Journal* for April, 1845.]

The following observations may be interesting to modern mechanics, not only by showing what has been done, or proposed, but as affording useful hints. The selections may not always appear judicious, yet when the subject is of little moment, it is sometimes associated with writers, customs, or historical data, &c., worthy of note; on the whole there may, I think, be drawn from them "both pleasing and profitable uses by those that have either witte, or will, to aplie them."

There are abundant proofs of a spirit of active enquiry into the useful arts in the latter part of the fifteenth, and throughout the sixteenth and seventeenth centuries. A few scientific men began the study of mechanical philosophy, and artizans became

alert to find out new inventions. In the reign of Elizabeth, English mechanics were repeatedly bringing forth novel projects, and soliciting exclusive privileges. Our information respecting the nature of the devices, is, however, exceedingly meagre; no doubt many were worthless, yet nothing is more certain than that during the administration of Elizabeth and her immediate successors, there were men in possession of the most valuable ideas, the maturity of which has since gone far to renovate society; but inventors, or projectors, as they were called, were considered little better than maniacs—they were staple butts for wits to expend their shafts on. Had any one European government of that epoch devoted a small portion of the wealth, lavished on court parasites, to the development of useful mechanism, the country might have been at this day in advance of all others.

In 1593, Hugh Platte, an English gentleman of education, and keenly alive to mechanical improvements, issued "An apologie for certain new inventions." Their *effects* only were described, but he was ready to exhibit the machines, and put them in operation upon receiving, or on having secured to him, a reasonable remuneration. Certificates, or recommendations, from competent persons accompanied the announcement, but all was in vain. Platte experienced the same species of neglect as his predecessors and successors did, and of which he justly complains.

In the following year he published a collection of various devices, not those referred to in his apology, but chiefly such as he had gathered from books, or from friends. Several he tested by experiments; his book is obviously similar to previous publications of the kind, resembling somewhat the pamphlets of Porta, Besson, Bates, Decaus, and Worcester. It is entitled "*The Jewell House of Art and Nature, conteining diverse rare and profitable inventions, together with sundry newe experimentes in the art of Husbandry, Distillation, and Moulding: faithfully and familiarly set downe according to the author's owne experience. By* Hugh Platte, of Lincolnes Inn, gentleman. London: printed by Peter Short, 1594," (upwards of sixty years before Worcester's Century appeared.)*

The work of 1594, is a small quarto, and consists of three parts, or rather three volumes, for each has a separate title-page; the first contains 96 pages, the second 60, and the third 76: the whole is dedicated to the unfortunate Earl of Essex, to whom Platte remarks that he had long buried (mentally) the contents of the book, but reflecting that all private labour should tend to the public good, he concluded to offer these labours *of his youth* to his country, under the protection of Essex, "because in these daies of deepest censure each author of nouvelties, be they never so really and roially performed, is every way in danger, both of sharp and sodaine reprehension, not only of the base and vulgar sorte of people that measure other men's conceipts by their owne, but of those also that have had some better education, and been brought up even in the same schooles, yea, and under the same tutors with them." He alludes to the jeers of his associates in the law.

In the preface he complains of opposition from both ignorant and informed, but, like Savery, he administers some smart fillips. An extract or two will convey a better idea of the difficulties inventors then lay under, between two and three centuries ago, than anything else.—"Because in my late apologie of certeine newe inventions I made a condecionall promise of some farther discoverie in arteficiall concepts than either my health, or leisure, would then permit; I am now resolved, notwithstanding the unkind acceptation of my first fruits, which then I feared and hath since falne out, is a sufficient release in law, of the condition, to make the same in some sort absolute, though not altogether according to the fulnesse of my first purpose, and I am the rather persuaded hereunto that I might both second my first labours with a fresh supplie of credit, as also for the better satisfaction, or rather suppression of all those *professed enemies of ingenious devices*, who, notwithstanding those manifold and inavoidable testimonies produced in the same apologie .... doe without all wit, reason, or humanitie, not only make a question of the possibility of them, but have both *utterlie condemned them* in their own conceipts, and pronounced their fatal sentence upon them in the midst of *much sacke and sugar*."

Inventors offered wagers to accomplish all they proposed:—"Yet herein I must of necessitie allowe of their grave wisdoms, who, being not able to rule their rash and riotous toungs, have alwaies shewed so great a government ovre their enchanting purses, as that all times when the question came to be tried by any round wager (which hath been oftentimes offered them in my behalf, and shal stil be maintained in despight of their ignorance,) they have presentlie shifted themselves by an apostrophe to a newe matter, as if they had spoken unawares they knew not what." ...... "But to leave these leaden

* In 1653, an edition was published in which the author is called "*Sir* Hugh Plat, of Lincoln's Inn, knight."

daggers with their golden sheathes to the cutlers' shops, where they would make a goodly shewe if they were hung up in a Michaelmas terme!"

He suggests that governments should patronize inventors:—"Were it the good will and pleasure of her most sacred majestie to propound some liberal stipendie for all such of her ingenious subjects as shall bring forth any profitable or rare particular for the general good of his prince and country, I would hope to see a newe revolution of the first golden age."

He refers to Latin, French, and Italian authors who had written on "rare and profitable inventions;" and mentions Albert Magnus, Alexis of Piedmont, Cardan, Mizaldus, Baptist Porta, Firovanto, and Wickerus. He apologizes "for introducing his volume in these flourishing, though *unrewarded daies* of skil and knowledge, when *so many editions* of excellent authors concerning the *same subjects* had been published." After observing that most of the foreign authors were untranslated—that much of his own treatise was new and fitted to the understandings of "rustical people, and plain clouted shooes," .... he asks why he should not give his country the fruits of his reading, study, and experiments. He anticipates from well-disposed readers a friendly plaudit, which was the most desired, or a free pardon for his temerity, being the least he could deserve.

The *first* volume or part contains 103 experiments, Worcester's "Century" consisted of just one hundred propositions—hence its name. Platte's book throws light on many things in Worcester's.

The first device relates to keeping fruits and flowers fresh after being gathered; this is the longest article in the book. At the close he tells us he has written a "conceyted booke of gardening," containing many new improvements, but declines publishing till he ascertains what reception his present book meets with; and intimates that if it should be no more favourably noticed than his "Apologie," (which he compares to the raven sent from the ark,) he will not give it to the public. "It is," he remarks, "all readie for the presse, and does only attende to see if Noah's pigeon (the present work) [w]ill returne with an olive branch, seeing his [r]aven hath as yet brought nothing with [h]er."

2. *A Perspective Ring that will discover [a]l the cards that are neare him that wear[s] it on his finger.*—This was an invention [of] some French gambler; it consisted of a [he]mispherical crystal, or rather of a minute [co]nvex mirror, set in place of a gem. The [we]arer, by stretching out his arm (as if involuntarily), "leaning nowe and then on his elbow," and other movements, so as to bring the ring into a proper position, could read in it the hands of every player. Platte says the secret was little known in England, because native workmen could not set and "foyle the stone so artificially as it ought to bee." He published the cheat to guard young men from card playing, by showing them one of the "many sleights and cousonages dailie practised in gaming and dicing houses."

4. *To Preserve Meat Fresh.*—The fowl, or flesh, was to be parboiled in a strong brine, after which it would keep fresh for three or four weeks in the hottest weather. He recommends it to seamen who "are forced sometimes to vittaile themselves in climates where no flesh will last sweet four and twentie hours." He mentions a custom of parboiling fowls, &c., in brine, and then placing them in pots filled up with lard, and so preserved for a considerable time.

5. *To keep Water fresh at Sea.*—By adding a little "oyle of sulphur;" some preferred oil of vitriol. He mentions distilling salt water as then practised. Sir Francis Drake, with whom he was familiar, it seems tried various modes of keeping water fresh; "and Captain Plat,* in whom Sir Francis Drake, for his good parts, did alwaies repose great trust," used to hang thick pieces of sheet lead in the centre of each cask; upon those the slimy matter collected, and was removed by drawing up the lead through the bunghole.

6. *A Merchant's Compasse.*—This was a mere indicator of wind; the rod of a vane was continued into a bed chamber, or other room, when an index and card on the ceiling enabled a merchant to ascertain at any time of the night the direction of the wind, and thus calculate the arrival of his ships. The device is inserted in several old collections. Schottus gives a figure of it in his Hydraulico Pneumatica, &c., page 321.

8. *On Secret Writing.*—One side of a letter was to be occupied with ordinary matters, and written with common ink; on the other side confidential subjects were to be written with *milk*. By holding the sheet to the fire the writing became legible. Gall water and a solution of copperas were also used as invisible inks, and cambric *handkerchiefs*, as substitutes for paper, a lady's ruff, or other white parts of female apparel. Another mode was to cut openings through any part of two sheets of paper; one was kept by the writer, and the other by the person addressed. When a secret was to be communicated, the writer laid his perfo-

* A relation of the author.

rated sheet over a blank one, and expressed his ideas on the open spaces only; then removing the perforated sheet, he filled up the spaces between the openings with ordinary matters, or with words at random. On receiving the letter, the person for whom it was designed laid over it his "key sheet," and read the important matter at once. Platte alludes to, but does not describe, the mode by which the Romans and Greeks sent orders to their generals, viz., by folding the paper round a short staff or baton, in a spiral direction, and then writing their directions upon it. On unfolding the sheet, the whole appeared in utter confusion. *

10. *To Harden Leather, and make it more durable for Pump Suckers.*—This device we have often met with; such early notices indicate an extensive use of common pumps. The leather was to be soaked in water in which iron filings had long lain, or in the water of grindstone troughs. "This," he observes, "has been found of good use by one of the pumpe-makers of our time." He thinks the reader may pump out of it other and better uses."

11. *A Conceipted Chafing Dish, to keepe meat hote upon the table without coals.*—A double dish with a cavity for an iron heater. This seems to have been an old device, and to have given rise to several others: of these Platte mentions "warming pinnes, or froes, which being put into thin cases, and those cases wrapped in linnen baggs, doe serve to heat bedds, and to cast one into a kindly sweat. The like device is used by others in conveying such iron pinns into hollow boxes of wood, first lined inwardly with metal, either to laye under their feete when they write, or studie, in cold weather, or in their coches to keep their feet warm."

12. *How to Roste Meat more speedily.*—Here we have the portable, or *Dutch oven*, of our kitchens. It was not an English device; this its name indicates, and Platte confirms. The particular improvement which gave rise to its present appellation is uncertain. It seems to have been made subsequent to the sixteenth century. This oven, like most of our culinary and kitchen apparatus, is not of modern origin; it is of classical antiquity,—the *clybanus* of the ancients, by whom it was made of pottery, iron, and bronze. The *curfew* in its general form and dimensions so much resembled the clybanus, that some antiquaries have deemed both to be one device.

The Dutch oven was made of earthenware and sheet-iron in Platte's time; whether it was first made of tin plate by British workmen, and at his suggestion, is doubtful. He describes it as made square, concave, or cylindrical, and either made of tin plates, or of wood and lined with them, "for the reflexion of the heate that is gathered within will make great expedition" in the cooking. At each side was to be a slit "to let in the spitte." "I have heard of the like devise heretofore executed by an outlandish potter, in burnte clay, for the which he had his privilege [a patent], but his devise wanted a cover; it was exceeding heavie, very apt to be broken, and not so strong in reflexion as this metalline devise, especiallie if it be kept clean and bright."

14. *How to turne five Spittes at once by one hande, whereby also much fier is saved.*—Four spits, or prongs, arranged round and united to a central one, to which the crank was attached. In old kitchens, when several joints were roasted at once, they were placed one above another on separate spits; hence fire-grates of great depth were required. The device obviated this, as well as the corresponding number of turnspits (boys). The source whence Platte drew the improvement was "Pope Pius the V, his Kitchen." Bartholomew Scappi, cook to the Pope, wrote a work on cookery, which he named the *Kitchen.*

(*To be concluded in our next.*)

RECENT AMERICAN PATENTS.

[Selected and abridged from Mr. Keller's Reports in the *Franklin Journal.*]

IMPROVEMENT IN FIRE ENGINES. *Gardner Barton, Jun.*—This engine has two single acting cylinder pumps as usual, but instead of being permanent they are each connected at their lower end with a branch of the main pipe, by a cylindrical joint at right angles with the axis of the cylinder, the joint consisting of an arbor attached to the cylinder, and fitting in a corresponding cavity in the pipe, the two being provided with openings, or cavities, constituting the water-ways which are opened and closed by the vibrations of the cylinder. The upper ends of the piston rods are provided with a pin that slides in a groove made in a guide rod attached to, and vibrating with, the cylinders—the piston rods being also connected with the brake of the engine, by slides that can be moved along the arms of the brake, and secured at any point desired to regulate the capacity of the engine; for the farther the slides are removed from the axis of the brake, the greater will be the play of the piston, requiring, of course, an equivalent increase of power for working the engine.

Claim.—"What I claim is the combination and arrangement of the cylinders with the guides attached, and their agreement

with the slides, by means of which the capacity of the engine may be enlarged, or diminished, at pleasure. I do not claim the invention of vibrating cylinders, but I do claim the invention of the application of the vibrating cylinders to the purposes of pumps for fire engines, in the manner herein before described. I also claim the opening in the upper ends of the guides on which the connecting pins act; and I claim the opening through the arbor, and the corresponding openings, (in the pipes) serving for water passages."

Governor for regulating the movements of mill wheels, steam engines, and other machinery. *Henry Burt.*—Instead of the balls and arms thrown out by centrifugal force, or jointed wings opened by the resistance of the air, as the velocity of the machinery is increased, the present patentee employs a vertical shaft with spiral wings, (made in the manner of the screw propeller,) and so placed in a vessel filled with water, or other fluid, that the resistance of the fluid acting on the spiral vanes, or wings, by the increased motion of the machinery, causes the shaft and vanes to rise, and when the velocity is diminished, and the resistance thereby reduced below the gravitating force of the weight of the shaft and wings, or vanes, it descends, and by its connection with the throttle valve of an engine, gate of a mill, &c., the moving force of the machinery is either increased, or diminished.

Claim. "Having thus explained my invention, I shall claim the employment, as a governor, of a screw, or other analogous contrivance, as described. to revolve in water, or other fluid, and act therein, and in all respects substantially as set forth."

Safety boxes for railroad axles. *Peter and William C. Allison.*—This is for the purpose of giving additional strength to the parts of the axle inside of the wheels where they are most liable to break, and consists of divided boxes made in two parts, with flanches at the end and sides, the former to secure them by screw bolts, &c., to the wheels, and the latter to bolt the two halves together, embracing the axle which is grooved in the direction of the circumference to receive fillets on the inside of the boxes.

Claim.—"What I claim as my invention, is the construction and arrangement of the safety boxes on the axles of the car wheels, having tongues (fillets) inside said boxes, fitting into corresponding grooves in the peripheries of the axles in the manner and for the purpose set forth, and rods, or hooks, with screw nuts for securing the safety boxes to the car wheels, as above described, or whether constructed in any other manner substantially the same, and for a similar purpose."

Improvement in the steam engine. *Joseph Frost.*—The patentee says, "I denominate my improved engine the reciprocating expansion engine, and I so denominate it because I use the same steam expansively in two, three, or more, cylinders in succession, each of larger capacity than that which precedes it. The first, or smallest, cylinder is to receive its supply of steam directly from the boiler, or generator, which is constructed and heated in the ordinary way. Alongside of this boiler I place steam receivers, or reservoirs, which I usually make cylindrical, and of the same length with the boiler; these I make capacious, say of half the diameter of the boiler, more or less; they are intended to receive the steam after it has acted in one cylinder on its way to that in which it is next to operate. These steam receivers I keep heated by causing the gaseous products of combustion to pass through flues below them, on their way to the chimney, instead of allowing them to pass directly thereto; the heat, therefore, which otherwise would be wasted, I employ to heat these receivers, and thus preserve and increase the elasticity of the steam during its passage from one cylinder to another. As the heat thus communicated to these steam receivers, will, in general, be sufficient not only to preserve the elasticity of the steam, but also, as above indicated, to augment it, I cause them to receive a small supply of water, which may be evaporated by this excess of heat, and thus operate in increasing the power of the engine without increasing the consumption of fuel."

Improvement in the mode of rendering fabrics water-proof. *Thomas B. Rogers.*—The following is the specification, viz.: "My improvement consists in rendering cloth water-proof by saturating it with a material which is insoluble in water, but which admits of the free passage of air through its fibres—a feature in which it differs from fabrics rendered water-proof by means of caoutchouc and similar articles. The following is a description of the process which I employ:—

"In a vat of suitable size I form a solution of sulphate of soda, or glauber salts, generally in the proportion of three quarters of a pound of the salts to a gallon of water, and in this I immerse the cloth; when it has become fully saturated, I convey it to another vat containing a solution of acetate, or sugar of lead, and permit it to remain there a sufficient time to enable a chemical re-action to take place between the solution of sulphate of soda with which the cloth was saturated before entering the second vat, and the solution of acetate of lead in this vat. The effect of this re-action is to make a

soluble acetate of soda, and in an insoluble acetate of lead—the former of which is dissolved in the vats, while the latter is precipitated among the fibres of the cloth, and forms the principal means by which I render the cloth water-proof. After taking the cloth out of this last vat I immerse it in another, containing a solution of sulphuric acid in the proportion of about sixteen drops to the gallon of water, for the purpose of rendering the lead in the fibres of the cloth a perfect sulphate. The cloth I afterwards pass through a solution of camphor in water, but which is not necessary to my invention, for the purpose of removing the unpleasant odour arising from the use of the acetate of lead. After which it is scoured with warm water and soap to remove the excess of acid, and any of the materials, or ingredients referred to, that may remain on its surface. I have mentioned sulphate of soda as one of the articles used in this process; this I employ only for the purpose of decomposing the sugar of lead as stated, and as there are several other sulphates which will produce the same effect, I do not intend to limit myself to the use of this, but to employ any of the others should I find it expedient to do so.

"What I *claim* as my invention, therefore, and desire to secure by letters patent, is the mode of rendering fabrics water-proof by passing them through successive solutions of sulphate of soda, or its equivalent acetate of lead, and sulphuric acid, as herein set forth."

IMPROVEMENT IN FISH NETS. *John Carr, Jackson Shannon, and William Carr.*—The patentees say,—"The nature of our invention consists in dividing a cylindrical net into different compartments, and furnishing each with a bait bag, the bait being suited to the different kinds of fish, and the large fish being prevented from entering the compartments of the smaller ones."

Claim.—"What we claim as new is the combination of a series of compartments in the manner and for the purpose described. We also claim the combination therewith of the bait bags, as specified."

The different compartments are separated by diaphragms of net work and funnels, the meshes in each succeeding one being smaller, so as to admit the kind of fish to be caught in the second compartment to pass through the first division, those to be caught in the third to pass through the second division, and so on.

IMPROVEMENT IN SPECTACLES. *Christopher H. Smith.*—The bows of these spectacles are without glasses, and to the main frame are attached, by swivel joints, two sets of different kinds of glasses; either or both of which can be brought to cover the open apertures or bows, and by means of the swivel joint the glasses can be turned so as to have either set let into the bows, and the other at the sides or over them, and thus the colours or focal powers may be changed at pleasure.

Claim.—"What I claim as my invention is combining the glasses with each other and with the main frame, by means of the hinge and swivel joint arrangement described, which admits of the glasses being changed, and at the same time adapted to the vacant apertures, all as set forth."

IMPROVEMENT IN ELLIPTICAL CARRIAGE SPRINGS. *David E. Edwards.*—*Claim.*—"I shall not confine myself to the method described of confining the ends of the plates; but I claim as novel, and of my invention, inserting between the main lower and upper plates of an elliptic spring, a double curved spring, or one forged into the shape of an oge curve, or approaching to that of the letter S, so as to divide it into two springs, and increase its rigidity, at the same time superseding the use of most, if not all the ordinary back plates; the whole being substantially as above described."

THE PADDLE-WHEEL AND SCREW.

The Royal Yacht Tender "Fairy."

We quote the following from a Portsmouth article in the *Morning Herald* of Thursday.

"This splendid little screw-propelled yacht, has arrived at Portsmouth, from the River Thames, and in her passage thither has established a very high character for herself as a sea boat, and has afforded another proof of the excellent practical working of the screw propeller. She had her compasses adjusted at Greenhithe, and left at 1.38 p.m. on Tuesday, the tide being about three-quarters flood at the time. At two o'clock she was abreast Gravesend; at 3.31, abreast the Nore light; 4.23, Herne Bay; 5.12, Margate; and at Dover, at 7.1. She stopped there four minutes, while Mr. Knight, the pilot, left the vessel, and then proceeded. She was off Dungeness at 8.44; Beachy, Head, 12.18; and entered Portsmouth Harbour yesterday morning at 38 minutes past seven; thereby performing the distance from Gravesend to Dover pier in exactly five hours; and the total distance from Greenhithe to Portsmouth, in 18 hours, including stoppage at Dover. From the North Foreland to Portsmouth, she encountered a head wind, which blew half a gale, and it increased when off Beachy, and thence to the westward. After rounding the South Foreland she met a heavy sea, that appeared suffi-

cient to smother the little yacht, but she shipped nothing but spray, which, as she cut through the waves, was occasionally dashed over the funnel top, and, through her not having any ports, the water was sometimes three or four inches deep all over the deck, the scuppers being insufficient to carry it off. The *Fairy*, however, was as stiff as a little frigate, and although once or twice, off Herne Bay, there was a disagreeable beam sea, she evinced no disposition to roll, nor to turn bottom up, as a certain sage of the Navy Office predicted she would. She is considered to steer as easy as a four-oared gig, even in a heavy sea. A single spoke of the wheel is sufficient for every purpose. On no occasion did the *Fairy* go less than 9 knots an hour through the water, and her maximum speed in running to Margate was upwards of 13 knots by Massey's log. From Margate to the Downs she hoisted her canvas, when she stood up under her sails very well, going 13 miles and 3-10ths, and with the exception of putting out the pilot, there was not the slightest occasion to stop the vessel throughout the trip, which circumstance considered with the great velocity at which her machinery works, cannot fail to impress every one with the degree of accuracy in its arrangement. The propeller, which on the average makes 13,200 revolutions per hour, cannot have made less than 237,600 during the run from Greenhithe to Portsmouth. At the latter place she is considered a most complete and beautiful vessel, and her fittings splendid in the extreme, reflecting credit on all parties engaged in her design and construction."

The preceding account commences with the starting from Greenhithe, but from another article in the same journal, the principal statements in which we subjoin, it appears that before she reached that point some incidents occurred, which it is equally due to truth to place on record.

"The *Fairy* started from off Blackwall Pier shortly before eleven o'clock. The *Meteor*, paddle-wheel iron steamer, constructed by Messrs. Miller, Ravenhill, and Co., with upwards of 300 passengers on board, was getting ready at the same time, for Gravesend. The *Fairy* had evidently waited for the *Meteor*, in order to make a trial of speed, as the Royal yacht had some time before cast off her hawser and was hanging on to the buoy. As soon as the *Meteor* got into the stream the *Fairy* followed her at a distance of three or four times her own length, and in the run to a little below Bugsby's Hole, that is, about half way to Woolwich, the *Meteor* doubled her distance from the Royal yacht. The latter then stopped, and so did the *Meteor*; and in the next short run—namely, to the point opposite Woolwich Dockyard, the *Meteor* left her in the same manner, in other words, at the rate of a mile and a half per hour, at the least.

"This trial with the *Fairy* is of more importance than a mere matter of rivalry between iron-ship constructors and engine-makers; it is of interest to science, as it tends to show that, for river navigation, the paddle-wheel is calculated to give a higher rate of speed than the screw; though it may, perhaps, be otherwise at sea in rough weather."

We are not aware that any material exception can be taken to the fairness of this trial on account of any difference in point of tonnage or steam power between the two vessels. The *Meteor* is 170 feet in length, and 18 in breadth; the *Fairy*, 145 ft. and 21·2 ft. The former draws 4 ft. 5 in.; the latter, 4 ft. 9 in. The cylinders of the *Meteor* are 37 inches in diameter—stroke, 3 feet; the cylinders of the *Fairy*, 42 inches—stroke, the same. The *Meteor*, therefore, though it is the larger and (perhaps) better-proportioned vessel of the two, and presents a less midship area of resistance than her rival, is decidedly her inferior in point of steam power.

We happened (being townward bound) to pass the *Fairy* during her voyage to Portsmouth, and must cordially subscribe to all that has been said in commendation of her external appearance. We never saw a more beautiful vessel—one which seemed to be at once so buoyant and so steady.

The "Water Lily."

[From a correspondent.]

The *Water Lily* left Blackwall at 37 min. past 1, on the afternoon of Thursday the 3rd inst., and performed the passage to Portsmouth Harbour in 17 hours 11 min., having had to encounter a strong head wind all the way from the North Foreland; her average speed during this trip being something over 14 miles an hour.

The following day the vessel went from Portsmouth to Swannage Bay, and back again, a distance of 94 miles, in rather less than 6½ hours; her average speed on this occasion being 14½ miles an hour.

On the 8th July, the *Water Lily* started from Portsmouth for a trip round the Isle of Wight, and performed the passage (including a run up to the Southampton Docks) and back again to Portsmouth, in 7 hours, having had a strong tide against her nearly all the way.

The vessel on every occasion proved herself an excellent sea-ship, having been exposed to some very strong winds and heavy seas, and is remarkably stiff under canvas, seeming as if she would sooner tear her masts out of her than list over beyond a

certain point. Her steering qualities are also first-rate. She may be left ten minutes or more, when under canvas, and hold a perfectly straight course, without the necessity of touching the rudder.

[The *Water Lily* is a smaller vessel, and of less engine power, than either the *Fairy* or *Meteor*. Her length is 132 ft.; breadth, 16 ft. 6 in.; cylinders, 29½ in.; stroke, 14 in. Seeing that she went the distance from *Blackwall* to Portsmouth in 17 h. 11 min., this is a greater performance than that of the *Fairy*, which took 17 h. 56 min. to perform the distance from Greenhithe (only) to the same port of destination.—Ed. M. M.]

REMARKABLE EFFECT OF THE LATE THUNDER STORM.

Sir,—If the following phenomenon is new, or likely to be of interest to your readers, you will please insert it in your next Number. On Sunday evening the 6th inst., the neighbourhood of Birmingham was visited with an awful thunder storm, which lasted about one hour and a quarter; the lightning was nearly constant flash after flash, with a heavy fall of rain, such as I never saw before. Next morning I visited a copperas manufactory (sulphate of iron), and to my surprise I found the whole surface of the copperas liquor which was in the crystallizing vessels completely of a blood-red colour. In the course of to-day a red powder began to separate from the liquor and fall to the bottom, so that by six o'clock in the evening the liquor had nearly resumed its original colour. It appears to me that the sulphate of iron had been decomposed by the lightning, and a peroxide of iron formed. I presume the sulphuric acid has been converted into sulphurous acid, and escaped. Probably this fact may throw some light on the application of electricity to agricultural purposes. There is no doubt but the electric fluid has the power of decomposing the salts of iron, and converting the iron into a peroxide, which we know absorbs ammonia rapidly. May not the peroxide, then, have the effect of retaining the ammonia until the vegetable takes it up by its roots for assimilation, and so act as a carrier of ammonia from the atmosphere to the vegetable? And may not all the alkaline, earthy, and metallic salts be decomposed in a similar manner in the earth, and not by vegetable life?

I am, Sir, your obedient servant,

R. W.

July 7, 1845.

NOTES AND NOTICES.

Telegraph over the Atlantic!—A writer in the *New York Tribune* suggests a plan for bringing Old England within a speaking distance. He proposes to run a copper wire, well covered, and as large as a pipe stem, from Nova Scotia to the coast of Ireland. This, as is thought, may be accomplished by winding the wire upon reels, and arranging it on board a steamer so as to be reeled off as fast as the boat goes, and dropped the whole width of the Atlantic. The writer says—"Its gravity would sink it to the depth where water was so dense as to be of equal gravity, and of course beyond the reach of any kind of collision. Beginning and ending upon a bold shore, beyond the reach of anchors, it would be out of harm's way, and exposed but to two kinds of accidents, viz., from separation by its own weight, and the loss of the coating with which the metal must be protected. The steamer *Great Britain* would carry more wire of this size than would extend to Europe, and its cost, I think, would be less than a million of dollars."

A Giant Stride in Photography.—A M. Martenz, of Paris, states that he has discovered the means of carrying on the Daguerréotype process on a gigantic scale. He can, he says, Daguerréotype an entire panorama, embracing 150 degrees!! His process consists in curving the metallic plate, and causing the lens which reflects the landscape to turn by clockwork. The lens, in turning, passes over on one side the whole space to be Daguerréotyped, and on the other side moves the refracted luminous cone to the plate, to which the objects are successively conveyed.

Patent Barrel Cleaning and Drying Process.—We some time since gave a description of the process for cleaning barrels, patented by Messrs. Davidson and Symington, which we had seen in operation at Messrs. Hanbury's brewery. We understand, that not only has this process been in constant operation, with the most beneficial results, in that immense establishment, and in many others in which it has been introduced, but that the method of producing a continuous stream of hot air, which forms part of the barrel-cleaning process, has been applied with great success and economy to starch-making, coffee-roasting, calico-printing, and other matters in which a high controllable temperature is required. We think it right to return to the subject of this important patent, because a paragraph from the *Birmingham Advertiser* has gone the round of the papers, assigning the embarrassment of Messrs. Alsopp, the Pale Ale brewers of Burton, to "the failure of a patent process which they had purchased." Now we are enabled to state, on the best authority, that Messrs. Alsopp's difficulties have no relation whatever with any patent, but have arisen mainly from want of sufficient capital to support their large export trade. A want, we sincerely trust, which will shortly be supplied. It is true that Messrs. Alsopps have made use of the process, but, as they themselves acknowledge, not in the manner prescribed by the patentee; while Messrs. Bass, their neighbours and rivals, have used, and are still using it, with the most complete success. Patentees have so much to contend against, and patentees of mechanical improvements such enormous expenses to incur, that they deserve all the assistance the press can afford them.—*Great Western Advertiser.*

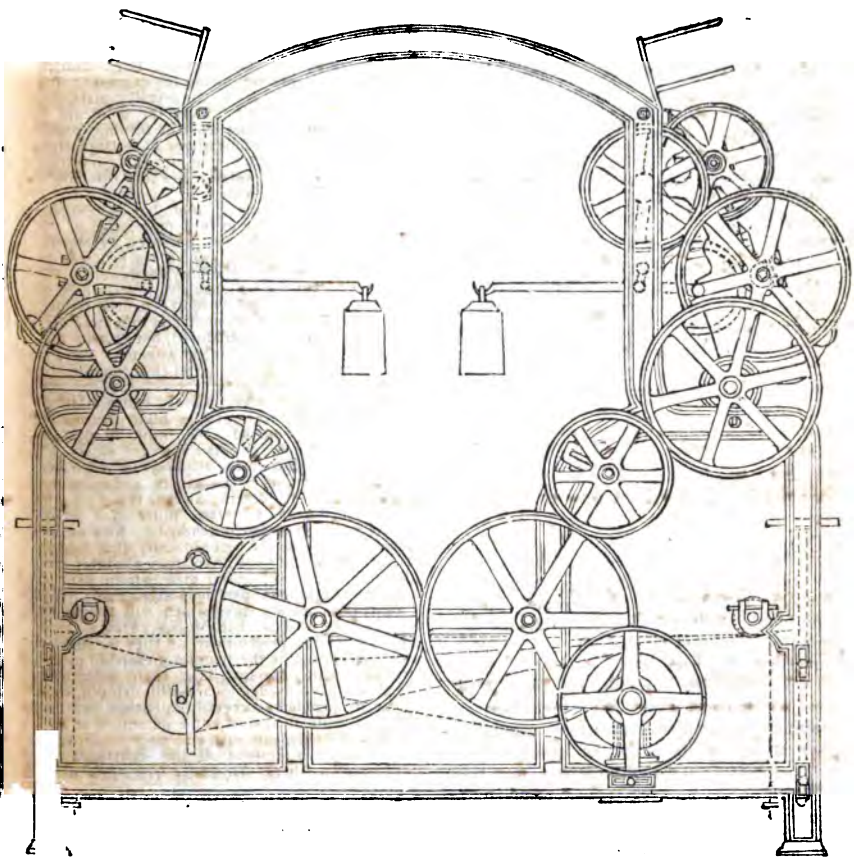
LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1145.] SATURDAY, JULY 19, 1845. [Price 3*d*.
Edited by J. C. Robertson, No. 166, Fleet-street.

MESSRS. RUSSELL AND PETER'S IMPROVEMENTS IN FLAX-SPINNING AND FLAX-SPINNING MACHINERY.

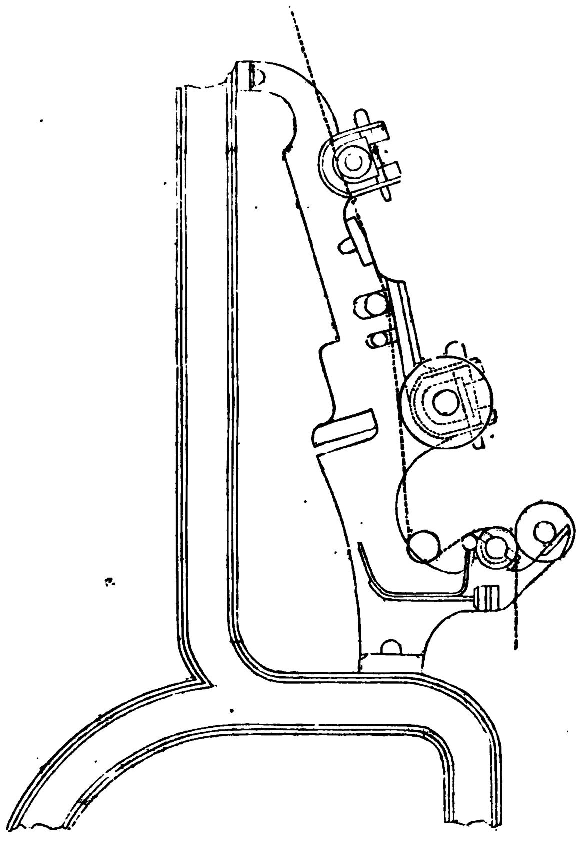
Fig. 1.



MESSRS. RUSSELL AND PETER'S PATENT IMPROVEMENTS IN FLAX-SPINNING AND FLAX-SPINNING MACHINERY.

[Patent dated January 6, 1844; Specification enrolled July 6, 1845.]

Fig. 2.



The present improvements, though they resolve themselves into what may seem at first sight but a small matter, are in truth of great importance. The spinning of flax, in overcoming the intractability of which, so much mechanical ingenuity has been already expended, is not only greatly facilitated by them, but thread of a much superior quality produced. The improvements consist simply in passing the slivers of flax through water, or through some colouring fluid substance, *while they are yet in an untwisted state*, and in the additions to, and modifications in, the ordinary spinning machinery required for the purpose.

Fig. 1 is an end elevation of a flax-spinning frame, adapted to, and embodying Messrs. Russell and Peter's improvements; and fig. 2, a sectional view of the parts to which their invention has more especial reference, detached from the rest.

A, fig. 2, is one of the retaining rollers; B, one of the drawing rollers; C is a trough, which is filled with water, or with some fluid colouring substance S S represents the sliver of untwisted flax which, after it comes from between the drawing rollers B, is carried under a small roller, D, which is partly immersed in the water, or colouring fluid, and

thence carried upwards, over and between two compressing rollers, E F, which keep the sliver still untwisted, and serve also to free it from any superfluous moisture which it may have taken up. The sliver, after being thus wetted or dyed in an untwisted state, is passed to the other parts of the machine, to be spun in the usual way.

Other fibrous substances, as well as flax, may be prepared for roving and spinning in the same way, with more or less advantage; and the patentees include in their claim a title to any such extension of their invention.

THE DAGUERREOTYPE PROCESS — THE LENSES PROPER FOR THE PURPOSE.

Sir,—In reference to Mr. Cumberland's suggested improvement in the Daguerreotype process, vol. xlii. p. 421, I beg to observe, that metal specula for taking daguerreotype portraits have been in use for three or four years, or more; but at the same time, I believe it would not be difficult to show that cameras constructed with a speculum were before known. The great expense and impossibility of making them accurate has, however, hitherto precluded their general use. One of Mr. Beard's patents includes the speculum camera.

Mr. Cumberland observes: "The mode at present practised is by refraction of the sun's rays through a convex lens, which, unless composed, as I have sometimes constructed them, of two plano-convex lenses, is always subject to limited aberrations, and, indeed, in all cases, gives a distorted image to a certain degree, although not always perceptible to the eye." This conveys the idea that Mr. Cumberland has, by combining two plano-convex lenses, succeeded in doing away with the aberration that has always been known to attend the images given by lenses of any, and every form. It would be a pity for any one to be led astray by such remarks to waste his time and money in fruitless experiments to accomplish an impossibility—viz., to cause any convex lens or any combination of lenses, however shaped, to make a clear, sharp, distinct image. No lenses or combination of lenses can do this, unless made of different refracting substances—none but *achromatic* lenses will do it. All those daguerreotypes made by specula that I have seen have not the sharpness *peculiar* to those made by achromatic lenses. We all speak by comparison. Mr. Cumberland may have found that *his* arrangement of lenses was the best *he* had tried. Mr. Hunt considers that a periscopic lens is the best. I have tried almost all the lenses and likely combinations in Sir David Brewster's volume on Optics (Lardner's Cyclopedia), and I simply beg to state the fact, that neither such lenses as have hitherto been known, nor any combination of them, have ever given or ever can, give a sharp image (except those called achromatic).* But an achromatic lens $3\frac{1}{4}$ inches diameter, and $15\frac{1}{2}$ inches focus, will not give an image clear and distinct enough for daguerreotype purposes; part of it must be stopped out so as to leave an aperture of only $1\frac{1}{4}$ inch diameter; if the aperture is made $1\frac{1}{8}$ inch diameter, the image will be so sharp, that any further diminution of the aperture does not perceptibly improve the sharpness of the image. Any one who has used an achromatic lens and seen the clear image produced by it, cannot afterwards call the images produced by other lenses *sharp*. *If* it was possible to form a correct-shaped parabolic lens, it would give a perfect image.

I am, &c.

HOMO.

Carmarthen, July 10, 1845.

P. S. Will any of your readers be kind enough to furnish a description of "Storer's Delineator"?

BAROMETRIC PRESSURE AT THE ANTARCTIC CIRCLE.

Sir,—The discovery of Sir James Ross, mentioned in your periodical of the 5th instant, "that a permanently low barometric pressure prevails over the whole of the antarctic ocean," however difficult to explain by modern modes of philosophising, presents no difficulty on principles truly natural.

The principles are these: Matter is inert; so must all bodies be inert; inertia implies want of ability to perform any kind of act to produce any kind of effect. Motion is not natural to anything material, moving being acting. There can be no

* For reasons, see any elementary work on Optics.

motion without previous impulse, nor continuous motion without equally constant impulse. In empty space there is nothing to impel the planets. Planetary motion implies the existence of a medium occupying the whole of the regions of planetary space; and as the common effect, motion, requires but the same universal cause, so is all motion caused by the pressure of the *all-pervading* motion of space.

Now, considering the natural fact, that space contains a medium which keeps the planets in motion, and that all motion has no other cause—how this medium makes bodies fall to the ground, and why the direction of descent tends towards the centre of the earth, induce the idea, that somewhat of a centripetal flow of the medium of space takes place, to produce the descent and direction of descent.

A centripetal flow of the medium of space into and from the globe of the earth, may take place under the following circumstances. During the different motions of the earth, the centre of motion may be at the axis or some proximate diameter. There the pressure of the medium of space will be less than at the surface of the globe, which will promote a flow centripetally of the same medium through all parts of the surface towards the centre of motion, and which will pass along the axis to have exit at the poles or at the polar circles.

Only by means of such a flow can we account for descending motion and its peculiar direction, and that all motion out of that direction is retarded, but in it is accelerated. It is by a flow of this kind the atmosphere is retained to the earth, which, otherwise would be left behind and pressed after the planet as in the tail of a comet, and the planet itself forced out of its orbit to become a comet. This flow makes the atmosphere heavy, and all terrestrial bodies have weight; and in the direction of the centripetal flow do all bodies ponderate. Weight is not natural to matter. Besides, something in continued flow must force from the polar circles the elementary matter of which the boreales consists. The compass needle indicates the act of a directing current; and whether the magnetic effect, as it is termed, depend on a polar flow of medium of space, or on some other elementary matter involved in it, subject to occasional interruption in its course by the non-conducting polar ices, certain it is, that a constant flow must have an equally constant supply.

The inferior, or minus-pressure effect on the barometric fluid at the polar circles, arises from the elementary matter of the boreales mixing with and becoming part of the atmosphere, and from the general pressure on it being as the size of its elementary atoms, which evinces the boreales emanations, than of the atmogreater rarity of the atmosphere with the sphere within the tropics; just as fire, flame or rarefied air at the top of a tube, the lower end of which is immersed in water, mitigates or intercepts, in degree, the force of the general pressure on the included water, so do the boreales on the barometric fluid for the above-mentioned reasons.

Thus, adventurously, in the teeth of the established philosophy of the age, are my opinions on the subject of pressure in the polar regions laid before your learned readers for their edification or correction.

T. H. Pasley.

Jersey, July, 1845.

CURIOUS PROPERTY OF THE PYTHAGOREAN ABACUS, OR COMMON MULTIPLICATION TABLE.

If the table be divided into compartments by vertical and horizontal lines, produced till they meet as in the opposite diagram, the sum of the numbers in each compartment, will be equal to the cube or third power of that number which indicates the place of that compartment. Thus, the number in the first cell or compartment at the top of the table on the left hand is 1, which is the cube of 1; the numbers in the second compartment, are 2, 4, 2, the sum of which is 8, or the cube of 2; the numbers in the third compartment, are 3, 6, 9, 6, 3, the sum of which is 27, or the cube of 3; the numbers in the fourth compartment, are 4, 8, 12, 16, 12, 8, 4, the sum of which is 64, or the cube of 4, and so on throughout the table carried to any extent we please. It therefore appears, that the sum of all the numbers in the table, is equal to the sum of the cubes of the series of consecutive numbers, 1, 2, 3, 4, 5, &c., carried to the extent of the table; hence an easy way of summing the series $1^3, 2^3, 3^3, 4^3, 5^3$, &c., to n^3, where n denotes the number of terms.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

It is obvious that each horizontal row of numbers forms an arithmetical series of which the common difference is equal to the first term; the sums of these series, will therefore form another arithmetical series, the common difference of which is equal to the first sum or term, or the sum of the numbers in the upper row, the last term being equal to the sum of the numbers in the lower row. Now, by the rule for summing an arithmetical series, the first term or the sum of the numbers in the upper row, is $(n+1)\times\frac{n}{2}=\frac{n^2+n}{2}$, which is also the common difference; but the last term of an arithmetical series, is equal to the first term added to the common difference multiplied by one less than the number of terms; hence we have

$$\left(\frac{n^2+n}{2}\right)+\left(\frac{n^2+n}{2}\right)(n-1)=\frac{n^3+n^2}{2},$$

the last term, and the sum of the term is

$$\left\{\frac{n^2+n}{2}+\frac{n^3+n^2}{2}\right\}\times\frac{n}{2}=\frac{n^4+2\,n^3+n^2}{4},$$

the same as the rule obtained by other means; the sum of the numbers in the above table is therefore,

$$\frac{12^4+2\times 12^3+12^2}{4}=\frac{24336}{4}=6034.$$

YACHT BUILDING.

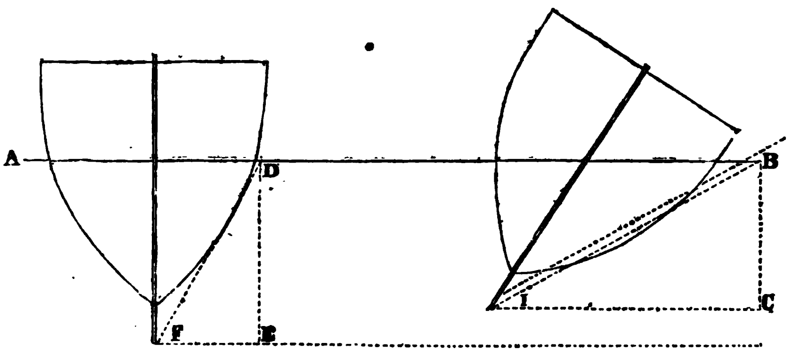
Sir,—Having seen a letter in one of your late Numbers on the subject of yacht building, and as it is one in which I feel great interest, and have availed

myself of every opportunity, both of observing different models, and practically testing the results as to their sailing qualities—an amusement to which I did always "most seriously incline"—and having on two occasions reduced my ideas on it into practice in two small vessels—I think, too, with rather a successful result—I send you a few observations on the subject, for insertion in your Magazine, should they seem likely to be of service. It is not my intention at present to make any observations on the wave line, nor on the remarks made on that subject in the letter of your correspondent "Forrester;" not that I underrate the importance of that point, or the assistance which a scientific investigation would afford in laying down the most eligible lines for the construction of vessels, but because I wish to confine my remarks to some other points, which seem to me of considerable importance, and yet not to be sufficiently considered, or to occupy so prominent a position in the scientific treatment of this question, as their practical importance would seem to entitle them to.

Persons in general seem to me to consider it too much as if vessels were impelled forward by some inherent principle of motion, acting horizontally, and not, as is the case in *sailing* vessels, by a force acting in a peculiar manner, and modified in its effects by a great variety of causes. Their different states, when in motion under sail, I will class under two heads. The *first* is, when the wind is more or less astern. In this case, the boat is propelled by the pressure of the wind acting altogether, or nearly, in the direction of her course; but as the resistance offered by the sails acts on a considerable lever, the mast, the tendency of the moving power is to bury the bows until they are sufficiently sunk to offer the necessary resistance. Now in this case the effect of a long fine bow, from whose facility in heading the water so much is expected, differs materially from those that were calculated on, because, from the sinking forward and rising aft, the theoretical lines have ceased to be the practical ones, and her horizontal section at the water line would now probably be an oval with large end foremost, instead of the reverse, as it was before. Again, an equal mistake would be made if the run should be made too fine; for vessels built thus, in scudding, are apt to settle by the stern, and are counted very dangerous. The *second* state is, where a vessel is said to be, on a wind; that is, when the direction of the wind is at either a right, or less than a right angle, with that of her course. In this case, her progress results from a less resistance being offered by the water to her moving ahead than laterally; in fact, its rapidity is proportionate to the comparative difference between the amount of both. I am aware that the difference of the angle at which the wind strikes the sails, and other matters of detail, cause irregularities of various degrees in the practical application of these general principles; but as these modifications are incidental to all forms, and do not particularly affect the principles themselves, I shall not dwell on them.

Vessels intended to go near the wind, or fast on it, are therefore generally constructed sharp in the bottom, with a deep draught of water, and a sharp entrance and run; this form being regarded as the one calculated to offer the greatest resistance to any motion in a direction at right angles to the vessel's length, and the least to one in the direction of it. Experience shows that it is a form which does not produce the full effect anticipated, besides being attended with some drawbacks. No boat sails upright (even the mere spars, lying to one side or other, tilts her, and the more so the sharper she is,) but in proportion as she is pressed with canvass throws up her side; the draught of water is thereby reduced, and the line of her side, from being tolerably perpendicular, is brought nearly horizontal. Thus the resistance her side offered to the water is greatly diminished, while the flat of her bow being sunk in it, her way is greatly retarded; and these tendencies, it must be recollected, increase in proportion as the wind does,—just the reverse of what would be desirable. The following sections will explain this better (See next page). No. 1 shows the vessel as she is intended to be; No. 2, as she really becomes. A B, elevations; D E, depth of bearing when upright; B C, as reduced; D F E shows the angle at which the resistance acted on the side, and B I C, the less favourable one to which it changes; causing manifestly a much greater lia-

No. 1. No. 2.



bility to drift sideways,—the water from the direction in which it is acted on, yielding with great facility. The very sharp entrance and run, when the draught of water is very deep, must greatly interfere with any length of floor, and therefore injure her seaworthy qualities, diminishing the ability of carrying sail, her steadiness and tightness in a seaway. The resistance, too, of a deep keel, acting at the extremity of the lever, must of course increase the disposition of a vessel to heel under sail, besides losing its effects in proportion as she does. Of late, I know, yachts have been built of great length to meet many of these difficulties; but, inasmuch as this renders it necessary greatly to reduce the beam, they are seldom able sea-boats. They are, no doubt, often very fast, and may answer very well for racing or river practice, under favourable circumstances; but beyond that I would not trust them much. And as people are apt to mast vessels more according to their length than their beam, they are in general quite oversparred for going to sea. Now it is not because I regard the defects to which I have alluded as capable of being completely remedied, that I have made these observations, but because I look upon them as inevitable, or at least to a certain extent more or less incidental to every form of vessel; and ought, therefore, to be more kept in mind in their construction than is done, and greater provision should be made for meeting the consequences of such disturbing causes, and moderating their effects. With this view, another gentleman and I constructed for our amusement a small boat of the form we thought most calculated to diminish or correct generally the objectionable tendencies. She was a small open boat, of about 21 feet on the keel, something about 7 on the beam, not drawing over 3 feet of water with two or three persons on board. The particulars of her mould are shown by the sketches figs. 1, 2, and 3. (See next page.)

She was what is commonly called a yawl, and therefore, of course, flatter on the floor than a cutter-built boat. The greatest breadth, as will be seen by fig. 1, was at, or just immediately below, the water line A B, from which she tumbled into the gunwale; the difference being about 2 inches of a side. Her floor, E, was straight, and she was turned up sharp at F. C D represents her water line when heeled under sail. The form of this section was adopted as the most likely, under general circumstances, to be the most affected by the lateral resistance of the water, as it secured the sides, being, when submerged by the listing of the boat from the pressure of the wind, in the position most sure of rendering that resistance effective; that is, nearly perpendicular. The stronger, too, the pressure was, the greater would become the surface of the side acted upon, the spread and straightness of the floor giving her great steadiness and power for carrying sail.

Fig. 2 represents a side view, in which A B is the water line, and C D E an imaginary one, pointing out the particular line throughout her length when the side is what is technically called *turned up*, and equally showing the position of her greatest bearing. The lines marked with the small letters, *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, are to give some idea of the form of the

Fig. 1.

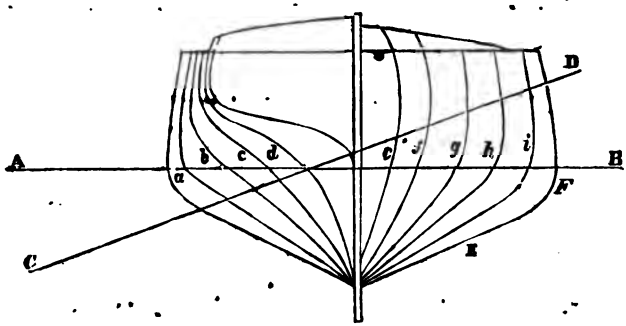


Fig. 2.

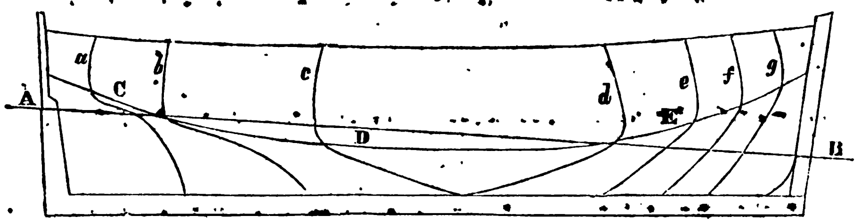
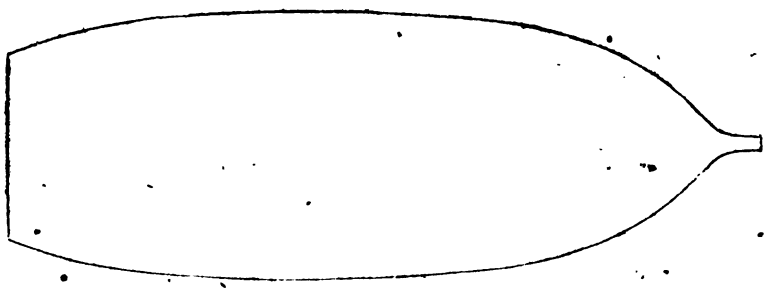


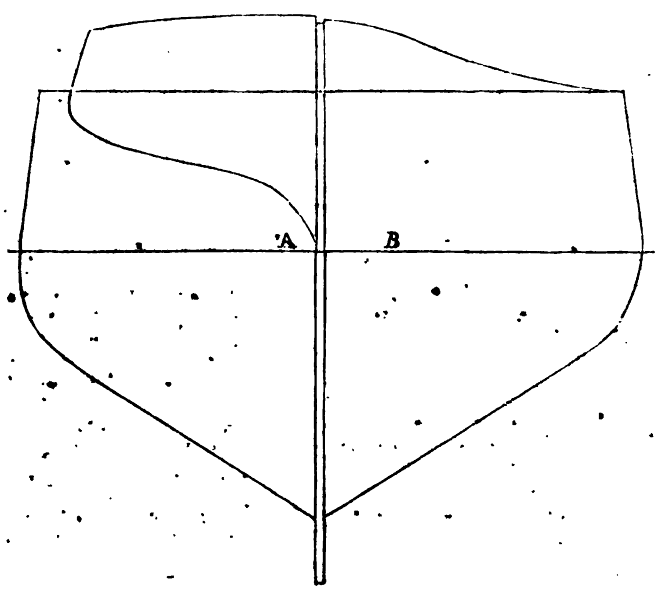
Fig. 3



timbers at a few different places. It will be seen by fig. 2 that her floor was both long and straight; an object, in my opinion, of great importance, whether we consider her power of carrying sail, or ability in a seaway; it also keeps tolerably horizontal, so that, though her entrance and run are both sharp, there are no sudden transitions in that direction. By this mould, too, great bearings are placed close to the water, which is also very desirable—ready for service when required in light winds—interfering but little with the facility of motion, but coming into operation in proportion as the pressure of the wind, and the demand for and utility of supports, increase. In fig. 3 the deck line is given for the purpose of showing that, to carry out the same principles, her beam was made not excessive, but generally diffused, carried well forward and aft; not differing, in several feet amidship, more than sufficient to prevent her being straight-sided (any perfectly straight lines I have always observed make a boat dull and sticky); thus her real bearing was more than if the beam had been greater; but in one

place her quarter was full and able (which is absolutely essential for cutter-rigged boats), and gently rounded, so as to prevent, as much as possible, any drag in her wake, while the long side bearing against the water checked leeway.

On trial these lines proved most satisfactory, and we had every reason to be pleased with her general qualities. As a sailing boat in light winds, she was as fast as any boat of her size, even when bearing to windward against a short head-sea—a severe trial, as any person will allow, to most boats; while when it was blowing hard I never saw her equal, carrying her sail and turning to windward like a large vessel; and though only boat built, with a light draught of water, drifting as little as those of twice her size. This was owing, I am sure, to the disposition of the different bearings alluded to above. She headed but little, too; not turning upon her side much, but settling steadily into the water, by which her powers were augmented as they were wanted. This was owing greatly to the form of her bottom, and the principal lateral resistance being high up. The ballast thus acted at one end of the lever, the pressure of the sail at the other, while the top side, resisting the side motion, acted as a fulcrum; whereas, had the principal resistance been made by the keel, the ballast and sails would, to a certain extent, have co-operated, in causing a contrary effect, while the equality of her bearings prevented much alteration in her trim fore and aft. Thus they were in action not much different from what they were when she was at rest; at all events, not more than there was a provision for meeting. Before the wind, from her shallow draught, and very steady floor, nothing could catch her. I do not mean that she excelled every boat in every good quality, for that would not be possible—for some, to be perfect, require peculiarities incompatible with excellence in others; but she certainly did surpass most boats of her size that she tried; indeed, I may say all, in the extent to which she combines a variety. In vessels of this mould it is much easier to stow the ballast, and in an effective manner; and their trim is less liable, of course, to error than those whose position varies constantly and greatly. Indeed, we were so well satisfied with this experiment, that we built another (with our own hands too), of about 15 tons, a cutter 27 feet 6 inches on the keel, and about 11 feet 5 inches on the beam; draught of water, 6 feet. Her lines did not differ more from the other than resulted from the one having been a yawl, the last a cutter, and therefore, of course, deeper in the hold, drawing more water, and having a sharper floor. The section was more of this form:



A B shows the midship's water line. The general principle of construction was the same, and therefore I need not enter into a more minute account of her. She has been out two seasons, and given equal satisfaction with the other, being a first-rate sea-boat, and when blowing hard, the best boat of her size I ever was in; and though a full-built boat—having been intended for all weathers—very fast.

There are many other points on which practically the sailing of a vessel greatly depends; but I have extended my observations more than was my intention at first, it having been mere my object to show the importance of considering points such as I have alluded to in the construction of vessels, than of entering into detail. I do not mean to say that they should be applied to their full extent in every case; principles must be modified according to the particular qualities required—to obtain one to sacrifice others; but I know from experience that attention to these accidental influences is not sufficiently paid, and that to produce good practical results it should be much more so. I do not agree with some of the points in "Forrester's" letter; but as I have trespassed more on your space than I fear is fair, I will not enter into that subject; but trusting that his remarks may draw attention to, and cause improvement in, so interesting a branch of art as the construction of good yachts,

I am, Sir,
Your obedient servant,
AN AMATEUR.

THE LONDON FIRE BRIGADE AND THE SUPPLY OF WATER AT FIRES. NOTES ON MR. BADDELEY'S REPORT OF "LONDON FIRES IN 1844," AND HIS "STRICTURES" ON A PAPER BY MR. BRAIDWOOD. (MECHANICS' MAGAZINE, NOS. 1127, 1130, 1131, AND 1133).* BY A FIREMAN.

Sir,—The great change which has taken place in Mr. Baddeley's opinion with regard to the London Fire Brigade, and more especially its respected chief, Mr. Braidwood, must have struck your readers with surprise, if not suspicion; but it is only by dissecting in detail his recent lucubrations, that the full measure of the injustice involved in that change can be made manifest, and a clear insight obtained into the motives which are at the bottom of it. I trust, therefore, that you will not refuse me the space in your pages which may be necessary for the purpose of such dissection, even though it should somewhat exceed ordinary limits. I shall not, at all events, occupy more columns in the justification of the Brigade and its superintendent, than Mr. Baddeley has done in vilipending them. I make this claim to indulgence with the more confidence, that the matters which are in question are as much of public as of private concern. The great utility of such an institution as the Fire Brigade no one yet has been heard to question; but to be useful to the highest degree of which it is capable, it must possess the entire confidence of the public. To cast doubts on the fitness of the individuals composing it, or any of them, for the duties with which they are entrusted, is more or less, therefore, to impair the general efficiency of the establishment. And to dispel such doubts, is at once to rescue private character from unmerited reproach, and to render an important service to the public.

To begin with Mr. Baddeley's Fire Report for the past year, and with the beginning, or rather heading, to that Report—Mr. Baddeley is there styled "Inventor of the Portable *Canvas* Cisterns." I believe that in these few words we have at once a key to all the soreness evinced by Mr. Baddeley in relation to the present subject. By referring to the last portion of his "Strictures," (No. 1133, p. 275,) it will be seen that Mr. Baddeley there claims the merit, not only of the "first idea" of these cisterns, but of all the perfection at which they have arrived; and is exceedingly wroth with the Committee of Managers of the Fire Brigade, and with Mr. Braidwood, for having somewhat slighted his pretensions on this score. Now a brief statement of the real facts of the case will show, incontestably, that Mr. Baddeley has in truth vastly overrated the value of his share in the affair,

* The writer of these Notes has to apologize to the readers of the *Mechanics' Magazine*, and also to the parties whose defence he has taken in hand, for not sooner availing himself of the opportunity of a "fair hearing" kindly accorded to him by the Editor in his Notices to Correspondents, of 26th April last. He withdrew the manuscript originally sent, in order to make some alterations in it, and has been prevented, by a pressure of occupations, from earlier returning it in its present amended state.—June 27, 1845.

In the *Mechanics' Magazine*, vol. viii., p. 190, Mr. Baddeley first described the "cistern of my own invention." It was a square box, 18 in. × 12 × 12, with a brass pipe to insert in the plug box; sides *fixed;* and not one word about *canvas.* This contrivance was objected to, because of the very great inconvenience of carrying a box of suitable size, one of the dimensions prescribed by Mr. Baddeley not being one-third of the size necessary; and, in point of fact, it never came into use. In November, 1834, Mr. E. Church, of Spital-square, wrote to the Committee of the Fire Brigade, proposing a box 3 ft. × 2 ft. × 14 in.; but this was also objected to for the same reason. In the discussion, however, which followed on Mr. Church's letter, Mr. W. M. Browne, of the Westminster Office, proposed that a cistern should be used having *folding down* ends, with *canvas* sides. One on this plan was accordingly made by the Superintendent (Mr. Braidwood), and was found to answer so well, that five or six were made, and brought into use. In 1838 Mr. Baddeley received a medal from the Society of Arts (*Mechanics' Magazine*, vol. xxxi. p. 119) for a portable cistern with *canvas sides and ends*—nearly four years *after* the *canvas cisterns* had been in use on Mr. Brown's suggestion; during all which time Mr. Baddeley had very frequent opportunities of seeing them. The pipe being inserted in the plug box was, however, still a very great objection; it admitted of only a very limited supply, and when the ground was soft, the water came up between the paving stones round the plug box. In 1840 a *canvas bottom*, with an opening bound with a broad piece of wash-leather was tried (not at the suggestion of Mr. Baddeley), and the thing was then complete. Every engine in the establishment has been since supplied with one of these portable canvas cisterns—of *canvas* both at the sides and bottom. In No. 1133, p. 276, Mr. Baddeley speaks of his "original *canvas*-bottomed cisterns;" but, as I have shown, Mr. Baddeley's original cistern was nothing of the sort. Canvas sides were not made use of till suggested by Mr. Browne, in 1834, seven years afterwards, and canvas bottoms not till 1838, four years later.

Mr. Baddeley is, I believe, right in what he states (No. 1133, p. 276) about Mr. Braidwood having endeavoured to prevail with his Committee to award Mr. Baddeley some pecuniary recompense. I have understood, however, from a member of the Committee that the recompense was not asked for on account of the invention of the cistern, or of any particular invention whatever, but of his general services as an amateur fireman, who had for some years made it his business to be present at every case of fire within his reach, and as a writer, who had been pleased to take the Brigade under his special patronage, lauded it prodigiously, &c. The Committee did not think his services as an amateur fireman had been of any value, and had a decided objection to paying any one for writing in favour of the establishment. The Committee may possibly have been wrong in this (though I, for one, should not say so); but why should Mr. Baddeley resent his disappointment on the Superintendent? Mr. Braidwood, at least, did all he could for him.

Mr. Baddeley states that—

"Mr. Braidwood found engines with 6-inch barrels best adapted to the requirements of the northern metropolis. On arriving in London, he found engines of greater power in use; but acting on his Edinburgh experience, he had them altered to the 6-inch standard. A very short time sufficed, however, to convince him of his error; and after deliberating between the choice of 7 or 8-inch barrels, Mr. Braidwood at last permanently fixed upon the former."—No. 1127, p. 185.

In these statements there is hardly a particle of truth. Mr. Braidwood never altered, nor caused to be altered, any engine in London to a less size than it was of originally; nor were there any 6-inch barrels used in the northern metropolis at the time he was there. Mr. Braidwood found 7-inch cylinders in use in London, and 7-inch cylinders are still those in use here. All that Mr. Braidwood has done has been to reduce the *weight* of the engines (a very different thing from reducing the *size*)—to improve their working efficiency—and to increase the height of the wheels, so as to render them of more easy draught; and in all these respects he must be admitted to have been eminently successful. The following comparative Table will show these facts at a glance:—

TABLE.

Engines.	Weight.	Power in cubic inches.	Extreme length.	Height of forewheels.	Height of hindwheels	Area of jet, in 16ths.	Cost.
	cwt.		ft. in.	ft. in.	ft. in.		£
Old ..	22	404	13 6	2 3	2 9	95	148
New ..	19	616	10 6	2 11	3 3	153	125

Mr. Braidwood having stated, in the paper by him, read at the Institution of Civil Engineers, that, "when two engines with 7-inch cylinders are worked together by means of a connecting screw, they make a jet very nearly equal (as 98 to 100) to that of an engine with cylinders 10 inches in diameter", Mr. Baddeley observes on this,—

"Here facts and figures are sadly at variance. On the 29th of January, 1839, a trial took place in Hyde Park between two of the Brigade engines, with 7-inch barrels connected, against one with 9-inch barrels, built for the Liverpool Fire Police, by Mr. Merryweather. Upon these occasions every possible effort was made to establish a superiority for the former, but *without success*, although the Liverpool engine laboured under some disadvantage from the contracted water-way of its hose, which was too small for an engine of such power—smaller even than that of the Brigade engines."—No. 1130, p. 230.

It will hardly be credited, but so it is,—the result of the trial here alluded to was exactly the opposite of what Mr. Baddeley alleges. To place this beyond all possibility of dispute, I subjoin a copy of the Report actually made on the occasion to the Fire Establishment Committee, to which is added an attestation of its correctness by Mr. Merryweather himself!

"*To the Committee for managing the London Fire-engine Establishment.*

"68, *Watling-street*, 29*th June*, 1839.

"Gentlemen,—In consequence of a desire expressed by several members of the Committee, that a trial should take place between a large engine with 9-inch barrels, built by Mr. Merryweather, for Liverpool, and two of the engines with 7-inch barrels used here, I this day took the three engines to the Serpentine River, Hyde Park. The two engines were connected by a breeching, so that the water from both was forced out of one branch pipe. Thirty-six men were placed at the Liverpool engine, and eighteen at each of the London. The nose-pipe of the Liverpool was 1⅛ in. diameter, and of the two, 1¼ in.—or as 81 to 100.

"On trial, it was found that the 36 men at the two-engines threw the 100 decidedly higher and farther than the 36 men at the large engine threw the 81. If the number of men had been proportioned to the size of the jet, the two engines would have had 40 men, and the large one 32·4.

"There is a farther disadvantage, owing to the great size and weight of the large engine, which is 20 feet long, and weighs 34 cwt., while the small ones are each 10 ft. 6 in. long, and weigh 18 cwt.

"I may also mention that the two engines had 60 feet of hose on, and the large one 40.

"I have the honour to be, Gentlemen, your obedient servant,

(Signed) "JAS. BRAIDWOOD, Supdt.

"*April* 16, 1845.

"The above is a correct statement.

"W. MERRYWEATHER."

(*To be continued in our next.*)

CONTRIBUTIONS TOWARDS A HISTORY OF INVENTIONS, OR MEMORANDA COLLECTED CHIEFLY FROM OBSOLETE AUTHORS.

[From the *Franklin Journal* for April, 1845.]
(Concluded from page 28.)

17. *To make a Pistol carry a Ball "point-blank eight skore feet."*—The barrel was to be *grooved*, like the modern rifle, with eight channels, the bullet "a thought bigger than the bore," and rammed home with "the skowering stick."

20. *To enable any Person to Walk on Precipices, &c., without danger of falling.*—He is to wear a pair of spectacles, the lenses of which are such as enable him to see things close to him only, "for it is the steepnesse that bringeth fear, and overturneth the brain." A person who played some antics on St. Paul's steeple "did help himself in his desperate attempt" with such spectacles.

21. *A round ball of Copper, or laton, that will blowe the fire verie stronglie, &c.*—The

eolipile, or philosophical bellows. (The cut resembles the one given in Ewbank's account of Hydraulic Machines, figure 286, on page 569.)

22. *Wooden Bridges* without fastening any timber work in the water.

27. *To handle hot iron, &c.*—Dipping the hand in glue, and then sprinkling horn ashes over it:—glue and alum, &c. (From Cardan and Wickerus.)

29. *To make a Candle give as much light as several.*—A double glass globe, the light placed in the inner one, and the outer filled with spirit of wine, or distilled water, like those in chemists' windows. A friend of Platte was shown the device in Venice. Polished reflectors are also suggested. Jewellers at the time used globes filled with water to engrave by at night. A lamp, or candle, being placed behind each. Platte, in his article, speaks of *magic cups*—"drinking bolles with false bottoms, wherein sacke, or claret, wine may be conveyed with fair water onlie in the uppermost part of the cup, whereby a plain meaning may easilie be deceyved." (See Hydraulics, page 520.)

34. *Ink Powders.*—Copperas, galls, gum arabic, &c., calcined.

37. *TransferringDrawings, oiled Paper, &c.*—The camera obscura for taking landscapes. The latter he does not explain, because of "the weake faith that reigneth in the world at this time." He probably took it from Porta's Natural Magic. He here mentions an inferior window glass then made in England.

41. *Speaking by Signs* "to be practised by such as doo naturally lacke their speech."—Substantially the same as now practised in deaf and dumb institutions. Signs for the letters of the alphabet were to be devised, "but the vowels for the more readiness thus: A, upon the tip of your thumb on the left hand; E, upon the tip of your fore finger on the same hand, and so of the rest, so as when you lay the index, or forefinger of your right hand on the tip of the thumb on the left hand; the partie may note the same for an A." He had seen a lady and gentleman converse in this way in a company.

48. *Candles and Lamps.*—The price of tallow was high at the time Platte wrote, [since] he advises the poor to make candles [by] dipping wick made of oakum in rosin, [and] use them in the chimney place. He [me]ntions floating lights for bed-rooms, and [rec]ommends lamps as far preferable for all [pur]poses to candles. One special advantage [wa]s that rats and mice could not convey [the]m into their nests, and set fire to the [nes]ts, as they often did with candles!

[5]1. *Oiled Paper in Windows in the six[tee]nth century.*—Thin parchment to be stretched and oiled, by which its translucency was increased. This he recommends in place of oiled paper, because it would not, like the latter, be destroyed by stormy weather; and he thinks it might be used instead of glass in such rooms as are "subject to overseers,—*i. e.*, to persons peeping through the windows. Landscapes might be painted on it "to make pretty shewe in your windowes."

99. *Projection.*—In this article he exposes the tricks by which itinerant jugglers, under the name of alchemists, deluded the unwary. He mentions a German artist overreaching some young and rich merchants in a very clever manner. As they were on the *qui vive*, he lulled their suspicions completely by proposing that they should make the experiment, and find anything while he would touch nothing. They, therefore, provided a crucible, coals and the quicksilver, (to be turned into gold.) The fire was kindled, one of them played the crucible under the nose of a bellows, as the juggler directed, another put in the mercury. When the contents were warmed, one of them was directed to give some gentle puffs with the bellows, as if to drive off the scoriæ, or oxide from the surface of the metal. Then the cheat handed a small paper containing only a *single grain* of the magic powder which was to work the change. In half an hour the crucible was removed, its contents allowed to cool, and an ounce of pure gold was found in the bottom, being the weight of the quicksilver put in!

In this instance the cheat had previously conveyed the gold disguised as an impalpable powder into the *nozzle of the bellows!* The mercury in the process was evaporated, and hence the result. Platte advises every one "besotted with this art," to look out for *false bottoms in crucibles, hollow iron rods,* by which the varlets stirred the metal, *fluxes* in the form of powders, and false backs to chimneys, or such as had a loose brick closely jointed, that might be removed by a confederate in the next room, and who, on a signal, ["as a hemme (!) or such like watchworde,"] given by the cheat while diverting the attention of the novice with a walk across the room, "and with the volubilitie of toung," may remove and convey some gold, or silver, into the melting pot!

51. *Heating by Hot Water—To Dry Gunpowder.*—Double vessels of lead, pewter, brass, or copper. The powder to be placed in the upper one, and the lower kept supplied with *hot water*.

50. *Cement for broken Glass.*—One part of virgin wax, and two of mastic, or fish glue beat till it becomes clear, dissolved in alcohol. This was used by a Dutch jeweller in

cementing two of the queen's crystal cups that were broken; others used isinglass dissolved in Rhenish wine.

92. *A strong Mortar*—for building, by mixing waste soap-ashes with loam and sand, with a little lime. Some builders used it without lime.

98. *The Art of Memory.*—Much the same as now taught. It was taught by "Master Dickson, the Scot, of late yeres in England."

101. *A Portable Wagon* moved by men within it for the use of soldiers. Nothing particular.

102. *A delicate Stove to sweat in.*—The portable vapour bath of modern days. Sweet herbs were placed in a caldron, and the vapour conveyed by a leaden tube into the bathing tub, where it issued through openings in a false bottom.

103. *Refining Sugar.*—Except the vacuum pan, precisely as now practised. The white of eggs to clarify the syrup. *Clay* put on the moulds, &c., "tempered like pappe with water," &c.

Tempering Tools.—In the SECOND PART, which treats of husbandry, he speaks of the value of salt in improving lands, and observes, "some kinds of salt doe so harden yron, and doe give such temper to the edges of weapons, as that one may cut yron with them as if it were a piece of wood."

Boring the Earth.—To find marl by which to enrich the soil, he says, "I think it necessarie that everie man shoulde have a long augur, or percer, with several large bitts which he may put on and take off at pleasure, and with these he may search at what depth he will, alwaies marking what several veins of earth he fyndeth in the bitt of the augur."

The THIRD PART relates to distillation. He mentions syphons under the name of "crooked pipes," but there is nothing particular worth extracting, *unless* it were processes for making ypocras, and other old drinks!

Platte has none of those ridiculous recipes which disgrace old works, such for example, as Cardan has given; one of which was to distil an illuminating liquid from the tails of glowworms! The whole is of a useful and practical character. In the part relating to moulding and casting there is nothing particular; flasks and moulds of plaster of Paris, sulphur, and wax, are mentioned.

The author winds up this book by an "offer of certain newe inventions which he will be readie to disclose upon reasonable considerations, to such as shall be willing to entertain them, or to procure some privilege for them. They are eight in number, but like Worcester's not fully described."

1. "*A newe kind of Fire.*"—He means a new fuel; from the cut representing it, and his description, it was what has frequently been since proposed, viz., a mixture of fine, or refuse, coal and clay worked up into balls of two or three inches in diameter. He says nothing of the materials, as a matter of course, but confines his remarks to the advantages of adopting it. It was "*cheaper* than sea-cole, sweeter in burning, and more regular shaped, being made in the form of balles." It was more *durable;* gave out *no smoke;* will employ thousands of poor persons to make it; will rather promote than hinder the *coal trade;* the materials abundant; will preserve timber for ships by superseding the use of wood for fuel; will reduce the price of fire wood and charcoal; and lastly, if introduced, ten per cent. of the profit may be given to the poor, and to maimed soldiers, &c.

2. "*A Vessell of Wood to brew, or boile, in.*"—He means the old wooden boiler with a cylindrical fire place of sheet iron, or copper, in the middle. If so he was not the inventor, since it was described by Gesner forty or fifty years before, and is found figured in most works on chemistry of the sixteenth century.* It might, however, have been little known in England, or he may have devised a modification of it; of its value he appeals to the proofs in his "Apologie, published Anno, 1593; and if there be anie person that, notwithstanding my testimonies therein produced, either perversely holds the same to bee impossible, or maliciouslie and slanderouslie reproove the invention of untruth; let him wage such a competent sum of monie as may counturaile (compensate) the discoverie of the secrets, and the author will make a public shewe thereof." He named it an *artificial Salamander.* It was cheaper than copper vessells—one would last twenty years—would save half the fuel usually consumed with others, and could easily be repaired by their owners.

3. "*A boulting Hutch.*"—A portable grist-mill turned by hand. A figure of this is given, but the interior is not exposed. It has six good qualities: its price moderate—it avoideth waste of meal and flour—saves bolters, which are costly—prevents uncleanliness in bolting. The objections made against it by the London bakers were false and malicious. It is durable, and will not be chargeable for rep irs.

4. "*A portable Pumpe.*"—A figure of this is also given, but the construction is wholly concealed. It is a forcing pump and a man works it without a lever. It is recommended as cheaper than any pump the author is acquainted with—light, and easily transported

* I have seen it figured in a German work on Distillation, published in 1527.

from place to place by one man—will deliver from four to six tons of water an hour; placed in a tub it can be used for draining fens, or forcing the Thames water into kitchens; and it is recommended to seamen as a good ship pump. There is one feature in the description which renders the rest very doubtful. He says a man may work it five or six hours without intermission, and cannot possibly be wearied! His remarks corroborate the opinion that forcing pumps were then little known in England. [See Ewbank's Hydraulics, pp. 295, 296.]

5. *A new kind of Bread* made in the form of wafers, and very cheap, with a *screw* press worked by a *pinion and cog-wheel*, for stamping, or forming, the wafers.

6. A mode of *banking earth* against the sea, or repairing breaches in canals, &c., with "artificial stones."

7. *Water-proof Garments*, light and proof against a continual rain, probably an application of a solution of india-rubber, or other gum. Caoutchouc was, however, then but little known, and according to some authors not at all.

8. "*A newe Conceit in Peter Works.*"—A device by which half the fuel expended in manufacturing salt-petre could be saved. He offered it to "the peter men" if they would give him one-third of the amount it saved them, but it seems without effect; perhaps an application of his wooden boiler.

The foregoing articles are the whole that appeared to have sufficient interest to be worth noticing. T. E.*

THE EXPERIMENTAL SQUADRON.

The following official return has been made to the Lords of the Admiralty, by the Commander in Chief of the Experimental Squadron.

Return of the Names of the Ships of the Experimental Squadron, the Number of Guns carried by each, &c.

Ships' Names.	Guns.	Tons burden.	No. of Men. Allowed.	No. of Men. Victualled.	Water in Tons. Can Stow.	Water in Tons. On Board.	Weeks' Provisions	Draught of Water. Forward	Draught of Water. Aft.	Draught of Water. By the Stern.	Height of lower deck midship port-sill from water	Square feet of Canvas in Sails.	Displacement.
								ft. in.	ft. in.	ft. in	ft. in.		Tons.
St. Vincent	120	2,612	840	705	530	504	21	24 3	26 2½	1 10½	6 1	25,160	4,484
Queen......	110	3,103	776	739	582	500	21	24 2½	26 4	2 1½	6 5⅝	28,000	4,405
Trafalgar..	120	2,694	840	681	512	507	21	24 5	24 11	0 6	6 1½	25,169	4,484
Albion.....	90	3,099	705	655	432	431	26	23 5	25 3	1 10	6 1½	30,000	4,152
Rodney....	92	2,625	705	619	435	410	21	23 8	24 9	1 1	7 4½	28,100	4,142
Canopus...	84	2,357	646	587	420	404	21	23 0	24 9	1 9	5 11⅛	28,100	3,567
Vanguard.	80	2,589	645	577	358	351	20	23 7	24 5	0 10	7 1	28,100	3,390
Superb.....	80	2,589	645	607	467	428	21	23 11	25 4	1 5	6 2½	28,100	3,440

The Portsmouth correspondent of the *Times* furnishes the subjoined additional particulars, which are followed by some very just remarks on the "want of fairness" shown in the selection of vessels for competition.

"The *St. Vincent*, 120, Captain Rowley, the flag-ship of Rear-Admiral Hyde Parker, Commander-in-Chief of the squadron, was built on the lines furnished by the late Sir William Rule; the *Trafalgar*, 120, Captain V. F. Martin, was built by Mr. Oliver Lang, Master Shipwright of Woolwich Dockyard, that Yard, in 1841; the *Queen*, 110, Capin Sir B. Walker, was built on the plan rnished by Sir W. Symonds, Surveyor of ɪe Navy, at Portsmouth Dockyard, in 1839; ɪe *Rodney*, 92, Captain Edward Collier, as built on the plans furnished by the late ir Robert Seppings (Surveyor of the Navy), ; Pembroke Dockyard, in 1833; the *Albion*, 90, Captain Nicholas Lockyer, was built on the plans* of Sir William Symonds, at Devonport Dockyard, in 1842; the *Vanguard*, 80, Captain G. W. Willes, and the *Superb*, 80, Captain A. L. Corry, were also built by Sir William Symonds (the former at Pembroke Dockyard in 1836, and the latter at the same yard in 1842;) the *Canopus*, 84, Captain F. Moresby, is of French construction, and was captured at the battle of the Nile.

"These are the eight ships forming the experimental squadron of 1845, which will sail from Spithead to try their respective qualities as models for future ships of their class. It will no doubt strike the reader, as it does us, as somewhat strange, and at

* We can hardly be wrong in supposing these to be the initials of Mr. Ewbank, the distinguished author of the work on Hydraulic Machinery.—Ed. M. M.

variance with those principles of impartiality upon which a squadron of such importance should be sent out for the attainment of so great and nationally important an end, that four of the eight ships composing it are by one constructor, and two of them of the same class.

"Again, it will be perceived that the *Albion*, two decker, of 90 guns, is of 3,099 tons burden, but her displacement is 4,152, tons, and she carries 432 tons of water, her weight of provisions being less than that of the *St. Vincent*, 120, three decker, by 168 days' consumption for 135 men; the *St. Vincent* also carries 98 tons more water, and her displacement is 4,484 ; consequently, the *St. Vincent* has a far greater burden to carry through the water than the *Albion*, yet has 4,840 feet of canvass less in her sails to enable her to do it! The Surveyor's 80 gun two deckers are each of the same tonnage, yet the *Vanguard* can stow 109 tons more water than her "sister" (the *Superb*)!

THE "METEOR" AND "FAIRY."

Sir,—Having been on board the *Meteor* during the trial with the *Fairy*, noticed in your last Number, I beg to be allowed to make an observation or two on the subject. The draught of water of the *Fairy* is stated at 4 ft. 9 in. This, as I was informed, was the draught when she was tried at Woolwich, with a quantity of ballast sufficient to represent all the freights that it was ultimately intended to have on board; but it does not follow that her draught of water was the same when she was tried with the *Meteor*. I think it could not have been so much.

In speaking of the respective powers of the *Meteor* and the *Fairy*, the speed at which the engines go has not been taken into account. I believe when the trials were made at Woolwich, the engines of the *Fairy* went 50 to 52 strokes,* whereas the speed of the engines of the *Meteor* is from 34 to 35 strokes. The power should be in the two cases (as the lengths of stroke are the same) as the square of diameter of cylinder multiplied by the number of turns or strokes per minute; and the engines of the *Fairy* were, I am informed, sold to Government for a greater power than such sized cylinders and length of stroke would give, in consequence of the increased speed at which they were intended to work. This, I think, perfectly right, as the boilers would, in consequence, require to be made larger, and all the bearings more carefully proportioned and hardened, and the engines generally more carefully made.

I am, Sir,
Your obedient servant,
R. S.

Limehouse, July 14, 1845.

Sir,—The poor little *Fairy* faring so ill in the wars by your last Number, compels me to ask you to insert the following truths at your earliest convenience.

With regard to the *Meteor*;—the *Fairy* was started from Blackwall at the convenience of her officers, and not purposely waiting for a race; and her stopping in Bugsby's Hole and Woolwich Reach, was, on both occasions, in consequence of derangement of her "patent" steering apparatus. When she did go on, it was evident to all on board that she was overhauling the *Meteor* considerably.

As to the passage of the *Water Lily* round to Portsmouth, wind and tide should be taken into consideration. The *Fairy* had very bad weather from the North Foreland; in fact, from Beachy Head, it blew a *gale* of wind dead against her, with a heavy sea.

Yesterday (at the departure of the fleet) she had to stop several times to keep her position *astern* of the *Victoria and Albert* and the *Princess Alice;* and in a short run she had with the *Water Lily*, she passed her hand over hand—in fact, the latter vessel did not come near again for the rest of the day.

Mr. Lloyd's experiments on 5th April, at the mile in Long Reach, gave the *Fairy* (the average of seven trials) 15·350 miles. Perhaps some of our fast friends will favour us with the result of their vessels' speed under the same severe test.

When the *Fairy* left Blackwall, she had a great quantity of stores on board, and 28 tons of coals.

I remain, Sir,
Your constant reader,
JOHN MATTHEW.

Greenwich, July 16, 1845.

* Probably when trying with the *Meteor*, the engines might have gone rather slower.

THE "WATER LILY."

On Wednesday evening last this vessel (50-h. p.) arrived at Blackwall from Portsmouth, having *performed the entire distance between daybreak and twilight*; she was under steam alone the whole time. The following are the times of her arrival and departure at and from different points:—

Left Portsmouth	4 14 A.M.
Off Dover	1 44 P.M.
At the Nore	6 18 —
Gravesend	7 46 —
Blackwall	9 3 —

The "Fairy."—Conspicuous among all the various beautiful specimens of naval architecture (on the departure of the experimental squadron) was the graceful little *Fairy*, Her Majesty's tender, which played around the Royal yacht, and turned about through the yachts and steamer with all the celerity and ease attributed to her aerial namesake. The slender tapering masts, raked symmetrically aft, and almost unsupported by the cobweb cordage of the shrouds and stays—her low and perfect mould melting away into the bows and run—her great speed—and, above everything, the absence of the swell caused by paddle-wheels—all combined to render her so attractive to the eye that she won on the affections of the men of the old school, overcame the prejudices of the Pipes and Trunnions, who "can't see much good in this steam after all," and forced an antiquated Sallyport tar to exclaim, "Why, though she arn't fit for a nor'wester, in-shore she frisks about like a lamb after its mother."—*Times*.

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No.166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

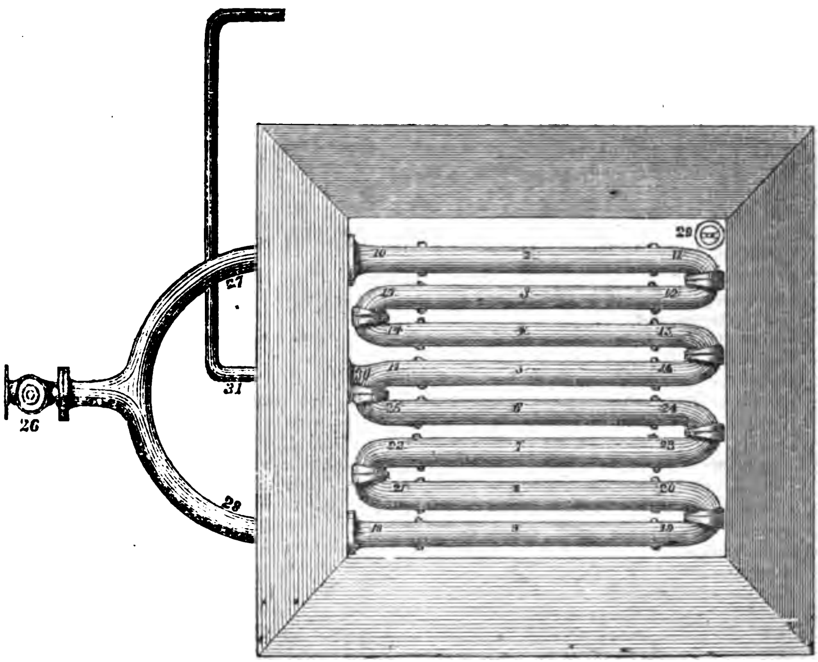
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1146.] SATURDAY, JULY 26, 1845. [Price 3*d*.

Edited by J. C. Robertson, No. 166, Fleet-street.

RONALD'S PATENT SUGAR-BOILING APPARATUS.

Fig. A



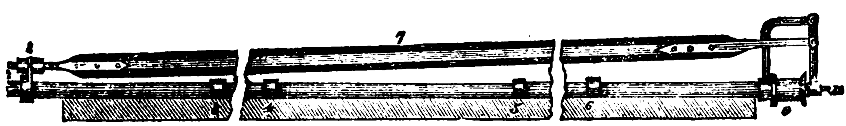
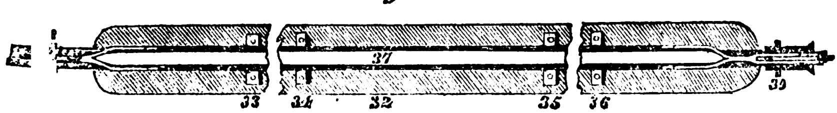


Fig B.



RONALD'S PATENT SUGAR-BOILING APPARATUS.

[Patent dated 5th December, 1844; Specification enrolled 5th June, 1845.]

Having, about the time this patent was obtained, thrown out some doubts as to its validity, on the ground that the advantages of sugar-boiling by steam had been long known, (See *Mechanics' Magazine*, No. 1122, p. 84,) we deem it but fair to Mr. Ronald, now that he has specified his invention, to lay his Specification before our readers, and leave it to speak for itself. Mr. Ronald, it will be seen, frankly admits, that "such applications (of steam) have been long known and freely used in Great Britain and Ireland and in the British colonies, and almost all parts of the world;" but claims the particular arrangements described, as being new and beneficial.

Specification.

"Now know ye, &c., &c. Fig. A is a ground view of the said apparatus. No. 1 an oblong chest or vessel with a high flange, made of wood or metal, and lined with copper or other metal, to contain the cane-juice or liquid which is to be boiled by the heat of steam. Nos. 2, 3, 4, 5, 6, 7, 8, and 9, continuous lengths of strong copper pipes, eight in number, for containing the steam; these pipes have bends of brass soldered on to their ends, which bends are jointed together by external and internal screws, and screwed up so as to permit a gradual descent on each piece of pipe from one end to the other, by which means the water formed by condensation in the pipes flows freely off; two of these pipes are of greater diameter than the others, for the purpose of creating a greater boiling power in a particular part of the chest or vessel. Nos. 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, and 25, are forked copper supports for the pipes, each being about $\frac{1}{16}$th of an inch shorter than the preceding one, for the purpose of supporting the pipes at the gradual descent fixed by the screwing of the joints. No. 26, cock to admit steam from a high-pressure steam-boiler or boilers. Nos. 27 and 28, pipes for admitting the steam at two places into the pipes in the chest. No. 29, valve in the bottom of the chest for discharging the contents, the bottom of the chest being sloped down to the valve so as to discharge the whole contents quickly. No. 30, exit for the water condensed in the piping. No. 31, pipe with a descent for carrying forward the condensed water to the self-acting expansion valve. No. 32, a strong plank of wood, on which is fixed a portion of the pipe, the said portion of pipe not being shown in this figure. Nos. 33, 34, 35, and 36, iron clasps for holding down the pipe to the plank. No. 37, a wooden pole, which keeps in a fixed place the plug of the valve. No. 38, two screw nuts, which can be moved so as to lengthen or shorten the pole when necessary, in order to regulate the plug of the valve, and then keep it in its fixed place. No. 39, self-acting expansion-valve, which discharges the condensed water in a most effectual manner. No. 40, a revolving fan, or agitator, made of copper or other metal or wood; it is worked by the rolling motion of the boiling liquid, and is so constructed that it can be placed as low or as high in the chest as is necessary; it consists of a spindle with flanges fixed to it, the spindle being a hollow cylinder which gives sufficient buoyance to the fan or agitator so as to float it on the surface, the journals of the spindle being guided in slots. Fig. B is a side view of the self-acting expansion-valve. No. 1, the plank of wood on which is fixed a portion of the pipe. No. 2, a portion of the pipe, which is fixed on to the plank of wood. Nos. 3, 4, 5, and 6, iron clasps for holding down the portion of pipe on the plank of wood. No. 7, the wooden pole. No. 8, the two screw nuts. No. 9, the valve. No. 10, the plug before described. Fig. C is a side section of the chest or vessel, with a flange. No. 1, the chest, with a flange. No. 2, cock to admit the steam from the steam-boiler. No. 3, one of the admission pipes for the steam. No. 4, part of the pipes. Nos. 5 and 6, two of the copper forked supports of the pipes. No. 7, valve for discharging the contents of the chest. No. 8, the revolving fan or agitator. Fig. D is an end section of the chest. No. 1, the chest with a flange. Nos. 2, 3, 4, 5, 6, 7, 8, and 9, forked supports for the pipes, showing the gradual descent of the pipes. Nos. 10, 11, 12, 13, 14, 15, 16, and 17, show the pipe. No. 18, the revolving fan or agitator.

"I do not claim as my invention the application of steam for boiling cane-juice [illegible]r other liquids; nor the application of pi[illegible]g to contain the steam for said purpose; s[illegible]h applications have been long known and fr[illegible]y used in Great Britain and Ireland, and [illegible]n the British Colonies, and almost all part[illegible]f the world. What I claim as my invent[illegible]n of the apparatus, of which the foregoing is a description, and which I believe to be [illegible]-tirely new, useful, and most effectual [illegible]r boiling sugar-cane juice and other liquid[illegible] is

as follows :—*Firstly*, I claim the invention of the plan of admitting the steam into the pipes at two different places, by which means the heating power of the pipes is greatly increased, compared with what it is when admitted at one place only. When the steam

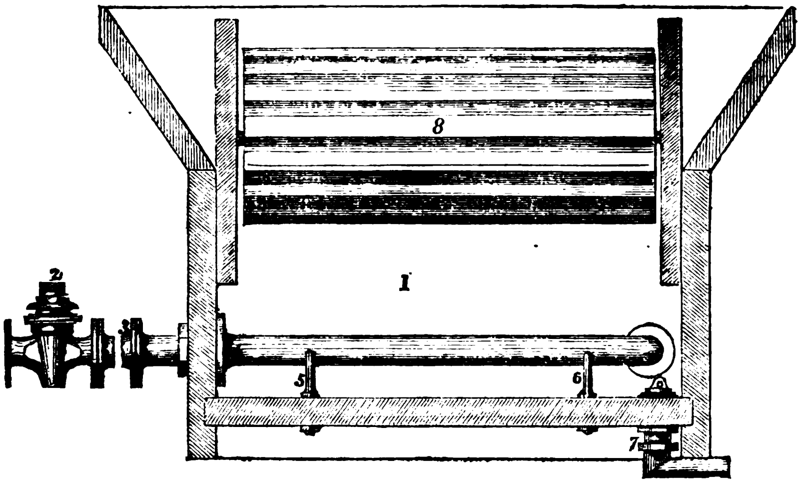
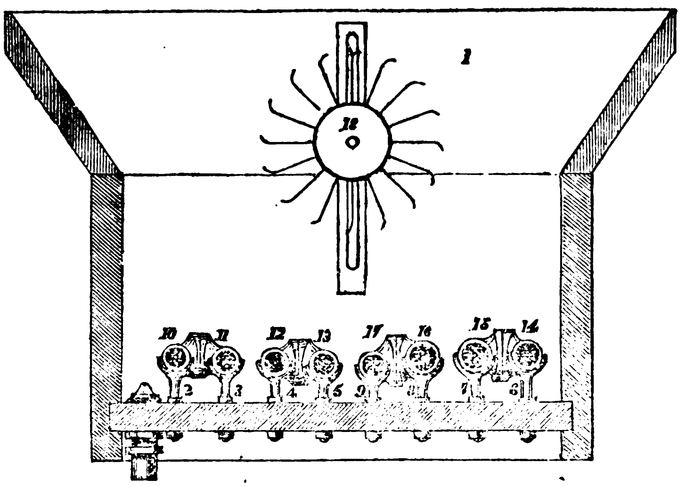


Fig D.



admitted at one place only, a great deal of heating power is exhausted before it hes the farther end of the piping. *Secondly*, I claim the invention of the plan of creating a much greater degree of boiling in a particular part of the chest or vessel, by

introducing into that particular part, piping of a greater diameter than what is in the other part of the chest or vessel—this causes a much greater ebullition; it also causes a constant and rapid rolling motion of the liquid from the one side of the chest to the other, thereby greatly increasing the evaporation, thereby causing the scum on the top to flow all to one side of the chest, where it can be skimmed off with ease, thereby preventing the liquid when it has become thick from settling down and charring on the pipes, and thereby driving or working the revolving fan or agitator. *Thirdly*, I claim the invention of the plan of driving a revolving fan or agitator, by means of the rolling motion of boiling liquid, in manner like an undershot water-wheel: by this revolving fan or agitator evaporation is aided. *Fourthly*, I claim the invention of the plan of joining the lengths of pipe by bends with external and internal screws, by which means alone lengths of piping of sufficient diameter can be placed close enough together, and at the same time afford the means of having a gradual descent from the one end to the other; it also affords the most convenient means of proving, by a force-pump, the strength and soundness of each piece of pipe before it is joined to the others. *Fifthly*, I claim the invention of the plan of forked supports for the piping fixed through the bottom of the chest, each support being about $\frac{1}{16}$th of an inch shorter than the one which precedes it, thereby meeting the descent which the external and internal screws permit in the piping. *Sixthly*, I claim the invention of the plan of affixing all the entrance and exit pipes at one end or side of the chest, by which means the expansion of the piping when heating, and the contraction thereof when cooling, will not injure the chest, or joints of the piping, and will render unnecessary the usual and troublesome plan of stuffing-boxes. *Seventhly*, I claim as my invention the self-acting expansion valve for keeping the pipes in the chest clear of the water formed by condensation. When no steam is in the piping, this valve remains fully open; but as soon as steam is admitted, the hot water from condensation, and at first a small portion of the steam, rush along the piping down to the valve; the piping is immediately lengthened by the heat, and the mouth of the valve advances up to the plug, which is kept fixed in its position by the pole; the valve is thereby shut, and the water collects in the piping, which thereby becomes less hot, and contracts in length just so much as to withdraw the mouth of the valve from the plug no farther than allows the water to trickle away without wasting steam.

"Although I have described particular plans to effect the objects of my inventions, and particular materials, and a particular mode of constructing the apparatus, I reserve power to use other materials in the construction, and other modes of accomplishing the said inventions or objects. In particular, I reserve right to make the chest or vessel of any other form or shape; I reserve right to use more than two pipes for the admission of steam; I reserve right to use such number of pipes in the chests or vessels as may from time to time be necessary; I reserve right of creating the rolling motion of the liquid by additional pipes in a particular part of the chest, or by leaving a part of the chest without pipes, or by any other plan which will effect the same object; I reserve right to drive or work any kind of machinery which I may apply, to effect the object of my said patent, by the force of boiling liquid; I reserve right to introduce into the chests half cylinders of copper or other metal or wood, which the rolling motion of the liquid may rush upon and over them, thereby increasing the evaporation, or to introduce any other contrivance to answer that purpose."

We cannot say that our former opinion of Mr. Ronald's invention has been materially changed by the perusal of this specification. Mr. Ronald does not seem to us to have carried the art of boiling by steam much, if at all, beyond the point to which it had been already advanced by others—Mr. Henry Crosley in particular. Of the things he claims, some are notoriously common property, others not worth claiming, and but a few of any real utility. Neither are his claims at all strengthened by the extraordinary chapter of reservations and qualifications with which they are fenced in; anything more outrageous in patent specifying we never read.

We extract from a circular which Mr. Ronald has addressed to the sugar-trade, the following business particulars:—

"The sugar which has as yet come home is not much improved in colour (by the patent process); but it is harder and drier, and the casks have been landed clean and dry, showing that there had been little or no drainage during the voyage.

"The following will be necessary for making two tons of sugar per day from cane-juice of an average quality:—A clarifier of 500 gallons; an evaporator of 500 gallons; a granulator of 220 gal-

lons; a steam-boiler, 21 ft. long and 4 ft. 5 in. diameter, with force-pump, furnace-mouth, grating-bars, &c. The whole complete will cost about 385*l.*, delivered in Glasgow. Upwards of 3000 lbs. of copper and brass will be used in making these articles; and as the price of copper frequently varies, so must the price of the apparatus."

THE LONDON FIRE BRIGADE AND THE SUPPLY OF WATER AT FIRES. NOTES ON MR. BADDELEY'S REPORT OF "LONDON FIRES IN 1844," AND HIS "STRICTURES" ON A PAPER BY MR. BRAIDWOOD. (MECHANICS' MAGAZINE, NOS. 1127, 1130, 1131, AND 1133). BY A FIREMAN.

(Continued from p. 42.)

Mr. Braidwood is next taken to task for preferring "the reciprocating motion to the rotary *for fire-engines.*" Mr. Baddeley asserts that such a preference is "wholly at variance with the opinions of nearly all our most celebrated mechanicians;" and after making sundry quotations, which are supposed to evidence this, from Buchanan, Desaguliers, and Ewbank, he triumphantly asks, "Can he (Mr. Braidwood) possibly suppose that his mere *ipse dixit*, unsupported by proof or experiment, will be tacitly permitted to overthrow the recorded and well-tested opinions of a host of talented practical men?" Now, with respect to the received doctrine on this subject, all that is true is this, that a rotary motion is generally considered to be more favourable for the exertion of human strength than a reciprocating—*all other things being equal.* Mr. Braidwood has never contested the truth of this as a general proposition, though Mr. Baddeley, with more trickiness than candour, affects to understand him as doing so; all that he has ever maintained is, that there are peculiar circumstances which make "the *reciprocating* the preferable movement *for fire-engines;*" and he so qualified his opinion in express terms. What those peculiar circumstances are he also stated:—

"Independent of its being the most advantageous movement (for fire-engines), a greater number of men can be employed at an engine of the same size and weight; there is less liability to accident with persons unacquainted with the work, and such as are quite ignorant of either mode of working, work more freely at the reciprocating than the rotary motion."—*Paper read at the Institution of Civil Engineers, quoted in Mechanics' Magazine, No.* 1131, p. 242.

Neither is there anything in the quotations from Buchanan and others but what is perfectly consistent with the existence of such exceptional circumstances as would take fire-engines out of the general rule. Mr. Baddeley is pleased, indeed, to tell us, that the "decreased liability to accident and the more free working of the uninitiated, are chimeras existing only in Mr. Braidwood's imagination;" but though it may suit his present purpose of undervaluing Mr. Braidwood to say so, he knows better. The old floating engines on the river were worked by rotary motion; and it is notorious that accidents were constantly occurring with these engines, from the unpractised hands, called in to assist, being carried round by the crank handles. Of the great difference between expert and inexpert hands in such cases, a striking illustration was afforded by a trial that took place in Sept. 1840, between one (the smallest) of these floating rotary engines, and the Fire Brigade reciprocating engine attached to the London Docks, which gave the following results:—

Experiments.	Brigade Reciprocating Engine.	Dock Rotary Engine.	Remarks.
[F]irst.	1¾ nose-pipe (196)	1½ nose pipe bare, (144)	Brigade decidedly the advantage.
[S]econd.	1½ ditto, bare (144)	1⅛ ditto (81)	Equal.
[T]hird.	1⅛ " (81)	1 ditto (64)	Dock decidedly the advantage.
[F]ourth.	1 " (64)	1⅛ ditto (81)	Equal.

[B]oth engines were worked by the same [num]ber of hands, but on enquiry being [made], how it happened that the Dock engine worked better than usual in the third and fourth experiments, it was found that the foreman had *for these trials*

picked out forty-five of the best *crane-men* out of some hundreds employed at the cranes in the docks; and who besides being picked, were in the habit of working a rotary motion all the year round, and therefore were each equal to at least two ordinary men at that motion. The Brigade engine, on the other hand was manned as usual by striking the gong, and taking all who came, old and young, without any selection. Such a trial (if it proves anything) proves that the rotary motion is not so good as the reciprocating, as, man for man, with picked men, accustomed to the labour, the advantage was only 26·5 per cent.; whereas, with such men, it should have been at the very least 50 per cent.

It is important, moreover, to observe, that though Mr. Baddeley throws the whole responsibility of the preference given to the reciprocating motion on Mr. Braidwood, (amiably anxious to throw as much on the Superintendent's shoulders as he can,) yet that gentleman only shares it with another, of much higher scientific authority, namely, Mr. James Walker, the late President of the Institution of Civil Engineers. The question was specially referred to Mr. Walker by the Committee of the Fire Brigade, and he gave a written opinion, founded on those very circumstances (among others) which Mr. Baddeley calls "chimeras," to the effect, that the reciprocating motion was the best "*for fire-engines.*" Mr. Baddeley knows this also very well, for he has more than once adverted to the fact in his communications to the *Mechanics' Magazine*— those of "lang syne," I mean, when Mr. Baddeley was not in the habit of suppressing anything that might serve to justify or exonerate the "gallant Fire Brigade," or their chief.

The consequence of substituting the reciprocating for the rotary motion in the case of these floating fire-engines, is, according to Mr. Baddeley, something worse than a mere loss of power.

"When some of the old crank-worked engines, which for nearly a century had been the 'pride of the Thames,' gave place to new ones, Mr. Braidwood introduced therein *his* 'most advantageous' reciprocating 'movement;' the result has been *unwieldy and unmanageable machines*, available only at an advanced period of a fire; and then more remarkable for the labour required to work them than for the efficiency of their performances—capable of delivering large quantities of water, certainly, but incapable of throwing clear jets of water to *ordinary elevations.*"—*Mech. Mag.* No. 1131. p. 243.

Perhaps the best answer to what Mr. Baddeley here says in dispraise of these engines, is to be found in what the self-same Mr. Baddeley said of them formerly, while as yet his judgment was unwarped by any unworthy feelings:—

"*It is a noble machine* (speaking of the two engines as one, because embarked in one boat), *and reflects great credit upon the designer* (*Mr. Braidwood*), *the builder, and the engineer*"*!!!*—*Mech. Mag.* vol. xxxiv. p. 169.

Any comparison between the old and new engines is, in fact, out of the question; and nothing but the extreme state of hallucination into which Mr. Baddeley has unhappily fallen, can account for his attempting it. The old "pride of the Thames," as Mr. B. facetiously calls the old Sun fire-engine, had but a $\frac{7}{8}$ in. jet=49: while the new engines are respectively of $1\frac{3}{8} = 121$, and $1\frac{5}{8} = 169$. Again, "the pride" never went to work without some part of the machinery giving way, while the new engines have never yet failed in any one respect. Farther, "the pride" could never move faster than any coal barge, while the new engines can be propelled at the rate of six miles an hour.

Not content with disparaging Mr. Braidwood's once freely acknowledged merits as a constructor of fire-engines, Mr. Baddeley would have us believe that the Superintendent knows nothing about what engines are capable of performing! Mr. Braidwood has stated that the quantity of water delivered by an engine is as the cubical contents of the cylinder; on this Mr. Baddeley observes—

"The quantity of water delivered by an engine of a given size, working at different speeds, is affected by contingencies, which Mr. Braidwood's paper, *as well as his ordinary practice*, shows him to be unacquainte with."—*Mech. Mag.*, No. 1130, p. 230.

Mr. Baddeley's proofs of this—wh are they? Very strange proofs inde —so strange, that were I to give them any other words than his own, I shou to a certainty be suspected of some gr travesty of his actual meaning:—

"The FACT is, the quantity of wa

delivered by an engine may be increased from 10 to nearly 25 per cent. BEYOND THE CUBICAL CONTENTS OF THE BARRELS (! ! !). An engine with two 6-inch barrels, and 8-inch strokes, by calculation and measurement gives rather more than 6 pints as the contents of each barrel; but with such an engine *I* have frequently delivered 8 pints per stroke, *being an increase of* 25 *per cent. beyond the calculated quantity.*"—*Mech. Mag.* No. 1130, p. 230.

This "fact"—great fact—of Mr. Baddeley's is not only no fact at all; but, as the scientific reader will instantly perceive, could not, in the nature of things, be a fact. The exploit which Mr. Baddeley avers he has "frequently" performed is simply an impossible exploit. He never did (this I make bold to affirm without any reserve) what he says he did. He might just as well have told us that he had many a time and oft made a pint pot hold a quart, or gone himself into the pot. The one thing would have been just as credible and as practicable as the other. The fact which he adduces in proof that Mr. Braidwood is "unacquainted" with the quantity of water deliverable by an engine, is but a proof of his own most lamentable ignorance on the subject, and his exceeding presumption (ignorance's usual companion) as a commentator on the labours of others.

Mr. Braidwood (in his simplicity, forsooth!) maintains that a considerable deduction must be made from the calculated quantities of water deliverable by an engine for the loss from the friction of the leathern hose; and this loss, he says, appears, from experiments he has made, to be equal to "2½ per cent. for every 40 linear feet of hose through which the water passes." Mr. Baddeley, while he tacitly assents to the truth of the general proposition, affects to treat it as a sort of practical absurdity, because, if followed out to its utmost limits, it would lead to a "total loss." This, however, is but another proof of the little he knows of the principles of hydraulic science. The hose *may* be of such length, and the friction consequently so great, that there *would* be a total loss or absorption of the forcing power employed. Startling as this may seem to Mr. Baddeley, it is nevertheless indisputably true. Mr. Braidwood's experiments may or may not serve to determine what the ratio of absorption is; but they are not, at least, to be discredited on any ground so silly as that taken by Mr. Baddeley. To my own thinking, however, they are entitled to the very greatest reliance; and perhaps there will not be many disposed to differ from me on this head, when I mention that, besides those detailed in the paper read before the Institution of Civil Engineers, there have been a great many more since made, which give precisely similar results. Of these later experiments I have been favoured with an authentic statement, with a copy of which I beg for the present to conclude.

Table of Experiments made to ascertain the Friction of Leathern Hose.

I. BERMONDSEY CHURCHYARD, 29th May, 1844.

Pressure 103 ft.

No. of Experiment.	No. of lengths of hose, with the length in feet.	Diam. of Hose.	Diam. of Delivery.	Rate of Delivery per minute in Gallons.	Loss per Cent. by friction. Gross Loss.	Loss per Cent. by friction. Loss per Length.
	1 = 40	2½	⅞	101		
	2 = 80	..	..	95	5·9	5·9
	3 = 120	..	..	92	8·9	4·4
	5 = 200	..	..	90	11·8	2·7
	7 = 280	..	..	83	17·7	2·6
	10 = 400	..	..	80	20·7	2·3

II. BATTERSEA, 6th July, 1844.

Pressure 120 ft.

	1 = 40	2½	⅞	101		
	10 = 400	..	..	84	16·8	1·6

III. Woolwich Dockyard, 6th September, 1844.
Pressure 38 ft.

No. of Experiment.	No. of lengths of hose, with the length in feet.	Diam. of Horse.	Diam. of Delivery.	Rate of Delivery per minute in gallons.	Loss per Cent. by friction.	
					Gross Loss.	Loss per Length.
2	1= 40	2½	⅞	68·0		
4	2= 80	..	..	65·4	3·8	3·8
6	3=120	..	..	63·6	6·4	3·2
8	4=160	..	..	62 5	8.0	2·6
10	5=200	..	..	60·0	11·7	2·9
12	6=240	..	..	59·7	12·2	2·4
14	7=280	..	..	57·4	15·5	2·5
16	8=320	..	..	56·0	17·6	2·5
18	9=360	..	..	54·7	19·5	2·4
20	10=400	..	..	53·0	22·0	2·4

(*To be continued.*)

ANOTHER GIGANTIC RELIC OF THE WORLD BEFORE THE FLOOD.

We quote the following remarkable statement from the *Mobile, United States Advertiser:*—

Our readers will doubtless remember the sensation produced in 1840, by the discovery of the bones of the great *Missourium*, of Missouri. We have now to announce that the same discoverer, Dr. Albert C. Koch, has brought to light fossil remains of a monster in the animal creation, that put in the shade the celebrated "Inguadon" of England, of colossal size, and the still more gigantic Missourium. The last discovery may be set down to the state of Alabama, and to the country adjoining Mobile, namely, Washington, being found imbedded in a yellow lime rock formation, near the Washington Court House. Dr. K. is a German by his birth and education; but has already acquired considerable reputation in this country for his geological researches and his ardent devotion to this cause of the natural sciences generally. He gives to this last most remarkable fossil wonder (which he describes as "the greatest wonder of this age of wonders") the name of *Zeulodon Sillimanii*," in compliment to professor Silliman, of Yale College.

The description of this monster is in substance as follows: "I have succeeded in bringing to light the very nearly complete skeleton of a most colossal and terrible reptile, that may justly be termed the king of the kings of reptiles. Its length is *one hundred and forty feet*—the solid portions of the vertebra are from 14 to 18 inches in length, and from 8 to 12 inches in diameter, each averaging 75 pounds in weight. Its greatly elongated jaws are armed with not less than forty incisor, or cutting teeth, four canine teeth or fangs, and eight molars, or grinders. These teeth all fit into each other when the jaws are closed, and it is clear that the animal was of the carnivorous nature. The eyes were evidently large, and were prominently situated on the forehead, giving the animal the power of keeping a constant and vigorous watch for its prey. The body had members attached resembling paddles or fins, which, in proportion to the size of the animal, were small and were doubtless intended to propel the body of this enormous creature through the waters of these large rivers and seas which it inhabited or frequented. Each of these paddles or fins is composed of twenty one bones which form in union, seven freely articulating joints. The ribs are of a very peculiar shape and exceedingly numerous. They are three times the thickness at the lower than they are at the superior extremity."

Dr. K. is at present in this city, and has the skeleton of this truly wonderful animal in his charge. The several parts are not yet joined together, but we understand he is willing to arrange and prepare them for exhibition, if there were any probability that he would be remunerated at this season of the year for his trouble and expense. Under the circumstances we presume he will take this rare curiosity, which of right belongs to Alabama, to some other place for its first exhibition.

Alabama is becoming famous for its fo[illegible] remains of prodigious large reptiles, wh[illegible] species became extinct long before Man w[illegible] created on the earth. There is in the St[illegible] Geological rooms at Albany, the spine of [illegible] animal some 80 feet in length, the verteb[illegible] of which are but little different in size a[illegible] weight to those named above. This ca[illegible] from Alabama, and is the property of Pr[illegible] Emmons.

ABSTRACTS OF SPECIFICATIONS OF ENGLISH PATENTS RECENTLY ENROLLED.

William Brunton, Jun., of Pool, near Truro, Cornwall, Engineer, *for improvements in dressing ores.* Patent dated Nov. 2, 1844; Specification enrolled May 2, 1845.

These improvements consist in submitting the ores to the action of a stream of water, by distributing them on an inclined table, moveable upwards against the stream, whereby the waste is washed off at the bottom of the inclined plane, while the clean ore settles upon the moving table, and with it is carried upwards beyond the influence of the stream, and ultimately deposited in a separate vessel. The moveable inclined table, which constitutes the principal feature of the invention, is constructed of a long sheet of painted cloth of suitable width, and united at the ends, by which it becomes an endless band; along each edge and on the outer side is sewed a strip of thick woollen cloth enclosing a soft hempen rope, which forms a ledge to prevent the ore from being washed over the edge of the table. The sheet of cloth is supported transversely by slight pieces of timber extending the width, and fixed at short distances by copper nails driven through the margin of the cloth into the pieces of timber. The inclined plane, or moveable table, thus prepared, is supported on a roller or cylinder called the head roller, about an inch longer than the width of the cloth, having bars fixed on its periphery in the direction of its length, and at such equal distances as will act as detents against the transverse timbers. This roller is supported by its gudgeons between two strong headstocks built into a wall or other sufficient means of support. There is besides what has just been described, a frame of timber about 18 inches longer than the inclined table, consisting of two side pieces fixed together by several cross bars of timber a little longer than the width of the cloth; on which cross these bars are fixed, four longitudinal planks or bearers for the moveable table to slide on when at work. At the lower end of the frame is fixed another cylindrical roller, called the foot roller, of the same length, and parallel to the head roller already described, and having its upper sur- ; in the same plane with the upper side he longitudinal bearers. The upper end he frame is supported by the head stocks ch carry the gudgeons of the head roller, . the lower end is supported by screwed '-, by which the inclination of the table be varied at pleasure. Upon the frame rollers thus arranged, the endless cloth ipplied, and made to pass from the head r along the longitudinal bearers to the foot roller, where it passes over a third roller fastened on the under side of the frame, between which and the head roller, the endless cloth hangs in the form of a catenarian curve, which dips abut 2 inches into a cistern full of water, where it deposits the ore as it is made to revolve.

The chief feature of novelty in this invention, and that which constitutes the claim of the patentee, is the dressing of ores upon an inclined plane, continuously or occasionally moving up against the stream, and by the same motion depositing the dressed ores in a separate vessel placed for the purpose of receiving it.

James Power, of Threadneedle-street, London, Merchant, *for improvements in the manufacture of candles and soap, and in treating a certain vegetable matter for such manufacture, and other uses.* Patent dated September 12, 1844; Specification enrolled, March 12, 1845.

The "certain vegetable matter" referred to in the title of this patent is "olive oil;" and the "improvements" claimed consist in the application of the "stearic and margaric acid of olive oil" to the manufacture of candles, and in the mode of treating the oil to obtain such acids.

The patentee's processes are as follows:—To every 100 lbs. of olive oil, he adds 14 lbs. of slaked and sifted quick lime, previously mixed with water to the consistence of cream. Steam is then admitted into this mixture through perforated pipes, till it is made to boil (stirring it occasionally), and it is maintained at the boiling heat for from 12 to 20 hours, after which it is covered up, and left to settle. The compounds of oil and lime are then taken out and dried, and afterwards crushed and sifted to bring them into the state of a fine powder. The lime that has been used in the first process is now saturated with as much sulphuric, nitric, or hydrochloric acid as is sufficient for the purpose, after being diluted with seven or eight times its weight of water, and brought to a boiling heat by steam pipes. To the dilute acid just mentioned, the powdered compound of lime is added with the fat acids, and the heat continued till the fat acids are set free, and float on the surface of the water, and the lime is precipitated in the state of sulphate of lime. The steam is then turned off, and the whole left at rest for some time. The supernatant fat acids are then drawn off, and washed well in the progress of cooling. The crushed fat acids are next transferred to a number of porcelain, glass, or stoneware vessels, set in a steam bath; and when they are melted, for every

112 lbs. 4 ounces of nitric acid, of specific gravity 1·3, are added, along with some small pieces of zink, and water to dilute the acid to about 3° or 4° of Beaume, which is from 1·02 to 1·027 specific gravity. The heat is continued for about two hours with occasional stirring; the vessels are then removed from the steam, their contents well washed with abundance of water, and set to cool in wooden vessels; the acid fat now assumes the appearance of tallow when perfectly cold.

This cold acid fat is next placed in suitable bags, which being inter-stratified with wicker plates and plates of iron, are put into a screw or hydraulic press, and exposed to a gradually increased pressure, till the oleic acid has been expelled in a liquid state. The pressed cakes are next to be melted in a boiler, heated by steam or otherwise, and 20 per cent. of alcohol, about 48° overproof, is to be well incorporated with the melted fat by agitation, when the mixture is to be drawn off into a vat, and left to cool and crystallize for fifteen or twenty hours. The solid fat acids thus obtained are subjected to pressure, and the cakes thus formed will consist of a mixture of margaric and stearic acids. The thin oily-looking liquid that runs off along with the spirits by means of the pressure, being received in proper vessels, is afterwards subjected to distillation, in order to recover the spirits for future use.

The cakes, when taken from the press, are melted in shallow leaden vessels with water, and the contents kept boiling by means of steam, while the surface of the fat acids is freely exposed to the action of the sun and air during from fifteen to twenty hours. The concrete fat acids thus obtained are bleached by subjecting each 112 lbs. to the action of 2 lbs. of sulphuric acid, diluted with 8 lbs. of water, mixed with 4 oz. of peroxide of manganese. These substances being mixed in a vat, are steamed by a perforated pipe connected with a boiler.

John Bower Brown, of Sheffield, Merchant, *for improvements in combining cast-steel with iron, and in the construction of carriage springs.* Patent dated, October 10, 1844; Specification enrolled, April 10, 1845.

1. In "combining cast steel with iron," as, for example, in making the tyre for railway wheels, the block of iron is heated to nearly the point of fusion, and placed in a cast-iron mould, of sufficient depth to receive the iron and the steel with which it is to be combined. As soon as the iron is put into the mould, the steel, which is ready melted, is poured into it, when the iron and steel combine into one mass, which is then drawn out into a bar, and afterwards passed between ground rollers, for the purpose of obtaining the section of tyre required.

2. As regards "carriage springs," the patentee's improvements are confined to such as are made up of a series of plates, which move or slide on each other. In these plates he forms channels or grooves, to contain grease or other lubricating matter, which will gradually work out from the recesses or grooves by the sliding action which takes place among the plates. The grooves or recesses are formed longitudinally when rolling the plates, instead of forming the plates plain on their surfaces; by which means, when the series of plates are put together to make up a spring, there will be grooves, or other shaped recesses, into which is placed the grease, or other lubricating material, for keeping the plates constantly lubricated while in action upon each other. Another part of this branch of the invention consists in forming the springs of two series of plates of different widths, instead of having them all of one width as heretofore. In carrying out this part of the invention, suppose the spring to be made is to be a strong spring for railway purposes, and that it is to consist of plates three inches wide; then, instead of having all the plates of this width, there is another series of two inches wide; and in making up a spring one of the narrow plates is introduced between each two of the wide ones, by which means the quantity of rubbing surface is lessened, and a very beneficial result obtained.

The patentee claims, *first*, his peculiar mode of combining cast-steel with iron, when manufacturing railway tyres; *secondly*, the constructing carriage springs of plates with grooves or recesses in them; and also the combining plates of different widths.

Alexander Parkes, of Birmingham, *for improvements in the manufacture of certain alloys or combinations of metals, and in depositing certain metals.* Patent dated October 20, 1844; Specification enrolled, April 29, 1845.

The patentee specifies five new alloys, composed of zink, tin, copper, &c., in various proportions, the distinguishing characteristics of which are, that they are of a white or pale colour and possessed of considerable malleability.

First Alloy.—33½ lbs. of foreign zin 64 lbs. of tin, 1¼ lb. of iron, and 2¼ lb. copper; or 50 lbs. of zink, 48 lbs. of ti 1 lb. iron, and 3 lbs. copper; or any oth intermediate proportion of the zink and co per. The iron and copper are first melt together in a crucible, and while in a fus state, the tin is added in such quantities at time, that the iron and copper shall not b come solid; the zink is then added, and t

whole well combined by stirring. The flux which is recommended for this sort of alloy, is composed of one part of lime, one part of Cumberland ore, and three parts of sal ammoniac (by weight). The alloy thus produced may be cast in sand or ingots for rolling as required.

Second Alloy.—66 lbs. of foreign zink; 32½ lbs. of tin, and 3½ lbs of antimony; or of 79¾ lbs of foreign zink, 19½ lbs. of tin, and 2¾ lbs. of antimony, or any other intermediate proportions of the zink, tin and antimony. As these metals melt at a low heat, they are melted in any convenient vessel of iron or clay, making use of the ordinary black flux, and when well combined, the alloy is cast into an ingot, or mould, as may be required. When the metal thus obtained is required for sheets, it is rolled cold, but when required for sheathing ships or vessels, from 8 to 16 ounces of metal arsenic is added for every 100 lbs. of the alloy.

Third Alloy.—45½ lbs. of nickel and iron in equal quantities, 45½ lbs. of copper, and 10¼ lbs. of foreign zink; or 30¾ lbs. of nickel and iron in equal proportions, 46 lbs. of copper, and 26½ lbs., or any intermediate proportions of the copper and zink.

Fourth Alloy.—Copper 60 lbs., nickel 20 lbs., silver 20 lbs.; or copper 60 lbs., nickel 10 lbs., silver 10 lbs., and zink 20 lbs. The copper and nickel are first melted together, and when these are melted the other metals are added either together or separately. The alloy thus produced, may be poured into ingots for rolling, or it may be cast into sand for any required purpose.

Fifth Alloy.—Nickel 25 lbs., iron 25 lbs., and copper 50 lbs. Or nickel 15 lbs., iron 25 lbs., and copper 60 lbs. The iron and nickel are melted together first, with either of the beforementioned fluxes; the copper is then added. This alloy is stated to be an excellent conductor of heat.

The same patent includes a method of depositing metals by employing a salt or salts of the metal intended to be deposited, (rendered liquid by heat,) together, or in connection with electric currents. The salts, are used in a state of fusion; those best adapted for the purpose, being the iodides, ch[illegible]ides and phosphates. For example, *to de[illegible]it silver from iodide of silver:* 6 lbs. of th[illegible]chloride are fused in a suitable vessel an[illegible] plate of silver suspended therein, which is [illegible]nnected with the negative pole of an el[illegible]ical apparatus; while the article to be sil[illegible]ed is also plunged in the liquefied salt an[illegible] connected with the positive pole. To en[illegible]ase the quantity of fused metal, without en[illegible]asing the expense in the same ratio (w[illegible]re a large bath is desirable,) iodide of po[illegible]sium is added to the iodide of silver in th[illegible]portion of from 3 to 10 lbs. of the former to 6 lbs. of the latter. The like in the case of gold, only that a much larger proportion of the iodide of potassium is used.

George Ferguson Wilson, of Belmont, Vauxhall; George Gwynne, of Princes-street, Cavendish-square; and James Pillans Wilson, of Belmont, *for improvements in treating fatty and oily matters, and in the manufacture of candles.* Patent dated, October 31, 1844; Specification enrolled, April 30, 1845.

The *first* of these improvements consists in effecting the acidification of fatty and oily matters by raising them to a high degree of temperature, and applying the acidifying agents directly to them, while they are in that state. Into the boiler containing the tallow, or other fatty or oily matter, a current of steam is passed, which has previously been raised to the temperature of 600° or 700° Fahr., by being conveyed through a fire in iron pipes, and the contents thereby raised to about 350° Fahr.—the steam and offensive vapour being carried off by a pipe from the cover of the vessel. The fatty or oily matter thus heated is run off into another vessel made of brick, lined with lead, and having a wooden cover lined with lead. Directly underneath this vessel, and extending across, is a leaden pipe, of about an inch in diameter, with a small perforation on each side at every 6 inches of its length. Through this pipe is introduced a mixture of 1000 lbs. of sulphuric acid, and an equal weight of water (the specific gravity of the acid being 1·8), which falls in jets into the heated fat, and causes ebullition, whereby the acid and fat are completely incorporated before the action of the acid is discernible by any material change of colour in the fat. As the ebullition ceases, the fat gradually blackens, and the matter is allowed to remain for about six hours after the ebullition has entirely ceased. The fumes and vapour produced by the above operation are carried off by a large pipe, which rises from the top of the vessel, and after descending, rises again into a high chimney shaft, which carries the fumes and vapours into the atmosphere. In the descending portion of this pipe, a small jet of water is kept playing for the purpose of condensing such parts of the vapour as are condensible; and from the lowest point of the bend the water escapes by a pipe into a drain made for the purpose. At the end of six hours, the product is pumped into another close vessel, and washed by boiling up with half its bulk of water; the steam which is rendered offensive by this process, being treated in the same way as the vapours from the former vessel. The water is then drawn off, and the washing repeated; but in this case the water is mixed with 100 lbs. of sulphuric acid. The

last product is then allowed to settle for a period of about twenty-four hours, after which it is distilled in an atmosphere of steam as often as necessary, until purified; the product of distillation is again washed, after which it is pressed, and then used in the manufacture of candles.

A *second* improvement consists in forming candles of fatty acids obtained without saponification, either by means of the first part of the invention, or by other direct means of acidification. The patentees prefer making the candles of two parts of fatty acid of tallow or palm oil, and one part of stearine of cocoa-nut oil. Or, when a very cheap composite candle is to be made, two parts of unpressed fatty acid tallow or palm oil are incorporated with one part of crude cocoa-nut oil, and three per cent. of wax, to amalgamate the ingredients, and prevent oiliness.

WILLIAM OXLEY ENGLISH, OF KINGSTON-UPON-HULL, DISTILLER, *for improvements in the distilling of turpentine and tar, and rectifying volatile spirits and oils.* Patent dated November 25, 1844; Specification enrolled May 25, 1845.

Mr. English's improvements consist,—*first*, in distilling turpentine and tar at a *low* temperature. And *second*, in rectifying the spirits from turpentine and tar and other volatile spirits, and also essential oils, at a low temperature.

The turpentine or tar is placed in an ordinary retort, with worm and receiver, to which an air pump is applied for the purpose of removing the atmospheric pressure. The result of removing the pressure is, that the spirit flows over at a lower temperature than when distilling in the usual way. The same thing holds good in rectifying spirits and oils.

ALPHONSE LE MIRE DE NORMANDY, OF DALSTON, GENT., *for improvements in purifying lac, and in converting lac into shel-lac.* Patent dated Dec. 7, 1844; Specification enrolled June 7, 1845.

This invention consists of two parts; *first*, in a method of ridding lac of the impurities contained in it, and converting it into pure lac or into shel-lac. And *second*, in a mode of manufacturing shel-lac from seed-lac, block-lack, roll-lac or lac pieces, and likewise reconverting into shel-lac any lac, which having been previously in the state of shel-lac, has become clogged or run together in blocks or pieces.

1. The lac is laid on a sieve, and immersed in alcohol, or some other menstruum, in which it is soluble, but which will leave the lac unaltered with respect to its properties. Heat may be employed to facilitate the process of dissolving the lac, and the vessel that contains the menstruum may be in the form of a still, provided with a worm tub to condense the vapours that arise during the process. When the lac is completely dissolved the sieve containing the impurities is removed, and heat being applied to the still containing the solution, the menstruum evaporates and leaves the lac in a melted state. The purified lac in this state is converted into shel-lac, by dropping it on a pair of revolving metal rollers, kept moist and cool by the application of water; these rollers, moreover, press the lac into a thin sheet, which is allowed to cool by sliding down an inclined iron plane, of sufficient length and inclination to admit the lac to slide down slowly.

2. A pipe is coiled into the shape of a funnel or cone, the coils being placed about a quarter of an inch a part; this funnel-shaped worm being placed above a pair of revolving rollers, steam is admitted into the pipe at a pressure of about 50 lbs. to the inch, or in lieu of it, water heated to 260° or 300° of Fahrenheit. The lac being put into the pipe becomes melted, and is converted into shel-lac by falling upon the rollers.

THE "METEOR" AND "FAIRY."

Sir,—Having seen in your last Number a letter from Mr. Matthew, of Greenwich, concerning a trial of speed between the *Meteor*, and Her Majesty's Yacht Tender, *Fairy*, I beg leave through the same medium, to offer a remark or two on the subject, particularly as to the alleged result.

Mr. Matthew states that when the *Fairy* went on, she "evidently overhauled the *Meteor* considerably," which is a fallacy—the fact being, that the *Meteor* was waiting in Bugsby's Hole for the *Fairy* to come up, when the second trial of speed commenced; and at Woolwich, the *Meteor* being a considerable distance ahead, her rival declined further contest by stopping.

As I was on board the *Meteor*, I can take upon myself to declare, that (as it is related in your Number of the 12th instant) she beat the *Fairy* at the rate of 1½ miles per hour.

With respect to the 28 tons of coals, which Mr. Matthew says were on board the *Fairy*, to her disadvantage, I can assure you that the *Meteor* had on board about 300 passengers, beside her usual stores, coals, &c., and calculating this, on the received datum of 13 passengers per ton, it gives for passengers alone 23 tons; which leaves no pretence for the stated disadvantage under which the *Fairy* was placed by her store of coals.

Mr. Matthew appears anxious to know the speed of the *Meteor*, and if he was

1¼ mile per hour to the *actual* speed of the *Fairy*, (with which no doubt, he is well acquainted) the result will give him the result he desires.

I am, Sir, your obedient Servant,

JAMES CRUDEN.

Gravesend, 22nd July, 1845.

NEW WORKS CONNECTED WITH THE ARTS AND SCIENCES PUBLISHED IN JULY, 1845.

MECHANICAL PHILOSOPHY, HOROLOGY and ASTRONOMY, being an Exposition of the Properties of Matter. Instruments for Measuring Time, and a Description of the Heavenly Bodies. By W. B. Carpenter, M.D., F.R.S. 9s. 6d.

LETTERS on the UNHEALTHY CONDITION of the LOWER CLASS of DWELLINGS, especially in Large Towns. Founded on the First Report of the Health of Towns Commission; with Notices of other Documents on the subject; and an Appendix, containing Plans and Tables from the Report (inserted by permission). By the Rev. Charles Girdlestone, M.A., Rector of Alderley, Cheshire. 1s. 6d.

THE JOURNAL of AGRICULTURE, and the Transactions of the Highland and Agricultural Society of Scotland, with Coloured Maps and Plates of the Geology of Roxburghshire. No. IX. New Series.

METROPOLITAN BRIDGES and WESTMINSTER IMPROVEMENTS. 6d.

THE GAUGE QUESTION. By Wyndham Harding. Evils of Diversity of Gauge, and a Remedy. With a Map. 1s.

A PRACTICAL MANUAL of PHOTOGRAPHY, containing full and plain Directions for the economical production of really good Daguerreotype Portraits, and every other variety of Photographic Pictures, according to the latest improvements; also the Injustice and Validity of the Patent considered, with Suggestions for rendering such a Patent a virtual Dead Letter, &c. By a Practical Chemist and Photographist. 1s. 6d.

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC., CAP. 65. FROM JUNE 26 TO JULY 22, 1845.

Date of Registration.	No. in the Register.	Proprietors' Names.	Address.	Subject of Design.
June 26	480	Douglas Hebson	1, Dale-street, Liverpool	Improved cast or wrought-iron bridge for the fires of steam and other boilers, with a valve and passage for the purpose of admitting air, in order to burn the smoke or gases evolved during the combustion of the fuel.
27	481	Samuel Reade.	77, Cornhill, London	A disc for near-sighted persons.
July 2	482	Joshua Leonard Brierley	104, Dale End, Birmingham	Improved expanding music folio.
3	483	John Powell	59, Paddington street, St. Marylebone	Lever rail for portable military bedstead.
„	484	Fred. Fovaux Weiss	Strand	Improved scarificator.
4	485	F. W. Lee	3, Grove cottages, Holloway	Domestic and portable fire-escape.
5	486	Adams, Jordan, & Co.	20, Pump-row, Old-street-road	Spring waggon.
„	487	John Dunton	Willenhall, Staffordshire	Case and staple for tumbler and spring lock for trunks.
„	488	Keeble Constable	Park-street, Cambridge	Improved trefoil and clover seed drawing machine.
8	489	Benjamin Rider	61, Red Cross-street, Southwark.	Hat leather.
9	490	Burge, Neate, and Co.	Batheaston	Self-regulating wind engine.
10	491	Abraham Newland	Stratford-upon-Avon	Flexible saddle.
11	492	David Glasgow	Birmingham	Portable fire-engine.
12	493	George David Doudney, and James Doudney	17, Old Bond-street, Westminster	Cloak.
„	494	Thomas Graves	Old Bolingbroke, Lincoln	Design for regulating the position of a ploughshare, and of coulter of a plough.
14	495	Edward Taylor Bellhouse	Manchester	Fireproof doors for hoists in mills, warehouses, and other buildings.
	496	Joseph Beaumont	Batty-street, Commercial-road.	Anti-friction valve.
	497	Lingham Brothers	170, Little Hampton-street, Birmingham	Union fastener for sashes and tables.
	498	John Bye	Titchbourne-court, Holborn	Bug trap.
	499	Jeremiah Johnson	Botley	Apparatus for raising and lowering persons and goods.
	500	Frederick Allies	Worcester	The Archimedean mirror.
	501	Henry Salter	29, Charing-cross, London	Spring soles for boots & shoes.
	502	James Balster Sampson	Maidstone	Spiral water heater.
	503	Edmund Rudge	Tewkesbury	Improved tap or cock.
	504	George Glover	Huntingdon	Safety horse-padlock.

LIST OF ENGLISH PATENTS GRANTED BETWEEN JUNE 26, AND JULY 25, 1845.

Isham Baggs, of Great Percy-street, Claremont-square, engineer, for improvements in obtaining motive power by air. June 26; six months.

Alexander Angus Croll, of Bow-common, Middlesex, chemist, for improvements in manufacturing, measuring, and transmitting gas, and in obtaining ammoniacal and other products from the refuse matters of such manufacture. June 26; six months.

Bower, St. Clair, of Manchester-street, Manchester-square, gent.; for improvements in the manufacture of sugar. (Being a communication.) June 26: six months.

Dominic Frick Albert, of Manchester, operative chemist, LL.D., for an improved application of materials to the manufacture of soap. June 28; six months.

James Hall Nalder, of Alvescott, Oxford, gent.; for improvements in drills for drilling corn, grain, and manure. June 28; six months.

Alphonse Le Mire de Normandy, of Dalston, Middlesex, for improvements in the manufacture of thimbles and finger shields. June 28; six months.

Simon Snyder, of Dayton, United States of America, mechanic, for improvements in tanning hides and skins. June 28; six months.

Charles Goodwin, of Bow-lane, Middlesex, ship-surveyor, for certain improvements in masts and spars. June 30; six months.

Philippe Poirier de Saint Charles, of Norfolk-street, Strand, Middlesex, civil engineer, for certain improvements in the production of type for printing, and in the machinery employed for the same. July 1; six months.

Stephen Hutchinson, of the London gas works, Vauxhall, engineer, for certain improvements in gas meters. July 2; six months.

Francois Marie Agathe Dez Maurel, of Marlborough-terrace, Old Kent-road, gent., for improvements in the manufacture of soap. July 3; six months.

John Hopkins, of 1, Rector-place, Woolwich, gent., for certain improvements in rails and trams for rail-roads and ironways. July 3; six months.

Thomas Walker, of Euston-square, mechanic, and George Mills, of Dover, coal-merchant, for certain improvements in springs and elastic power, as applicable to railway carriages and other vehicles, and to other articles and purposes in which springs or elastic power is now used. July 3; six months.

William Simmons, of Oldham, in the county of Lancaster, hat manufacturer, for certain improvements applicable to hats, caps, and bonnets. July 3; six months.

William Mather and Colin Mather, of Salford, Lancaster, engineers, for certain improvements in boring earth, stone, and subterraneous matter, and in the machinery, tools, or apparatus, applicable to the same. July 3; six months.

William Newton, of Chancery-lane, civil engineer, for certain improvements in railways, and in the means of propelling carriages. (Being a communication.) July 3; six months.

Lemuel Goddard, of Crescent, America-square, merchant, for improvements in the manufacture of candles, and in the means of preventing them from guttering whilst burning. (Being a communication.) July 3; six months.

William Symes, of Victoria-road, Pimlico, grocer, for certain apparatus for dividing lump sugar. July 3; six months.

George Myers, of Laurie-terrace, Westminster-road, Lambeth, builder, for improvements in cutting or carving wood, stone, and other materials. July 8; six months.

Jacob Brett, of Hanover-square, Middlesex, esq., for improvements in propelling carriages on railways, and other roads and ways. (Being a communication.) July 8; six months.

John Greenwood, of Church, Lancaster, manufacturing chemist; John Mercer, of Oakenshaw, Lancashire, chemist and calico-printer; and John Barnes, of Church, in the same county, chemist, for certain improvements in the manufacture of certain chemical agents used in dyeing and printing of cottons, woollens, and other fabrics. July 8; six months.

John Leifchild, of the Minories, blue manufacturer, for improvements in the manufacture of blue to be used as a substitute for stone blue. July 8; six months.

Antoine Bossy, of Paris, merchant, for improvements in manufacturing waterproof paper. July 10; six months.

John Samuel Templeton, of Sussex-place, Kensington, artist, for improvements in propelling carriages on railways. July 12; six months.

Edmund Ratcliff, of Birmingham, manufacturer, for a certain improvement, or certain improvements in the furniture of door-locks and latches. July 12; six months.

William Chantrell, of Leeds, gentleman, for certain improvements in weaving machinery. July 12; six months.

Joseph Fulton Meade, of Dublin, gentleman, for certain improvements in steam-engines and boilers. July 12; six months.

Samuel Tretheway, of Water-grove Minx, near Stoney Middleton, Derby, civil engineer; and Joseph Quick, of Sumner-street, Southwark, engineer, for an improved combined expansive steam and atmospheric engine. July 12; six months.

Horatio Sydney Sheaf, of Waterloo-place, Old Kent-road, artist, for certain improvements in obtaining and employing motive power. July 12; six months.

Thomas Russell Crampton, of Southwark-square, engineer, for improvements in match-boxes, or articles to be used in the production of instantaneous light, and in the machinery for manufacturing the same. July 12; six months.

Richard Simpson, of the Strand, London, gent., for certain improvements in bleaching yarns and fabrics. (Being a communication.) July 12; six months.

Joseph Malcomson, of Portlaw, Ireland, for improvements in apparatus used for propelling carriages on roads, and vessels on inland waters when employing atmospheric pressure. July 12; six months.

John Shaw, of Broughton, Lancaster, chemist and druggist, for a hydro-pneumatic engine. July 12; six months.

Patrick Sandeman, of Greenside-street, Edinburgh, upholsterer, for improvements on coffins. July 21; six months.

John James Sinclair, of Helmet-row, Middlesex, hot-presser, for certain improvements in producing glossy surfaces on paper and similar materials. July 21; six months.

Thomas Robinson Williams, of Love-lane, Aldermanbury, gentleman, for an improved process and machinery for rendering paper and wrappers waterproof. July 21; six months.

Julius Adolph Detmold, of the City of London, merchant, for improvements in the means of applying steam as a motive power. (Being a communication.) July 21; six months.

William Broughton of New Basinghall-street, London, millwright, for improvements in machinery or apparatus for grinding grain, drugs, colours, or other substance. July 21; six months.

Thomas William Gilbert, of Limehouse, Middlesex, sail-maker, for improvements in the construction of sails for ships and other vessels. July 21; six months.

Angier March Perkins, of Francis-street, Regent-square, of an extension for the term of five years of an invention for certain improvements in the apparatus or method of heating the air in buildings, heating and evaporating fluids, and heating metals. July 21.

Jacob Brett, of Hanover-square, Middlesex, gentleman, for improvements in atmospheric propulsion, and in the manufacture of tubes for atmospheric railways and other purposes. (Being a communication.) July 21; six months.

Michael Perrier, of Lymington, gentleman, for improvements in spinning and twisting cotton, flax, silk, and other fibrous materials. (Being a communication.) July 21; six months.

John Lings, of Spur-street, Leicester-square, cheesemonger, for improvements in apparatus for the preservation of provisions. July 21; six months.

Charles de Bergue, of Arthur-street, West, London, merchant, for certain improvements in rollers and other machinery or apparatus to be employed in flattening, preparing, and polishing wire for the construction or manufacture of reeds for weaving the rollers, being applicable to other like purposes. July 24; six months.

James Stokoe, of Newton, Northumberland, millwright, for certain improvements in purifying the vapours arising from smelting and other furnaces, and in recovering therefrom any useful matters which may be intermixed therewith. July 25; six months.

William Henry James, of Clement's-lane, London, civil-engineer, for certain improvements in the manufacture of plates and vessels of metal, and other substances suitable for heating purposes, and in the means of heating the same. July 25; six months.

Richard Archibald Brooman, of the Patent Office, 166, Fleet-street, London, gentleman, for certain improvements in dyeing. (Being a communication.) July 25; six months.

LIST OF PATENTS GRANTED FOR SCOTLAND, FROM THE 22ND OF MAY TO THE 22ND OF JUNE, 1845.

Henry Jones, of Nos. 36 and 37, Broadmead, of St. James's, Bristol, baker, for a new preparation of flour for certain purposes. Sealed, May 27, 1845.

Charles Joseph Hulmandel, of Great Marlborough-street, Middlesex, lithographer, for certain improvements in producing patterns upon earthenware and porcelain. May 30.

James Heath Lewis, of Dover, Kent, printer, for certain improvements in printing. June 2.

John Kingsby Huntley, of John-street, Minories, London, merchant, for certain improvements in the manufacture of manure. (Being a communication from abroad.) June 4.

Arthur Parsey, Spur-street, Leicester-square, Middlesex, artist, and scientific draughtsman, for improvements in obtaining power. June 6.

Thomas Lawes, of Old Kent-road, Surrey, gentleman, for improvements in propelling carriages on rail and other roads, and boats or vessels on canals or rivers, which improvements are also applicable to machinery in general. June 9.

William Shepherd, of Manchester, Lancaster, calico printer, for certain improvements in the art of printing calicoes and other surfaces. June 11.

..njamin Seebohm, of Horton Grange, Bradford, ..shire, mechanist, for an improved mode of ..ufacturing certain descriptions of chains. ..e 11.

..seph Washington Tyson, of Burton-crescent, ..dlesex, engineer, for improvements in fire-..s and ordnance. (Being a communication from ..oad.) June 12.

..oseph Quick, of Sumner-street, Southwark, ..rey, engineer, for an improvement in steam-..ines. June 12.

..enry Whiting, of Southwark-bridge-road, Sur-.. hatter's furrier, for certain improvements in ..hinery or apparatus for shaping the brims of .. June 17.

Warren Delarue, of Bunhill-row, Middlesex, manufacturer, for improvements in covering the surfaces of paper and other materials with colour, and other substances. June 17.

John Dewrance, of Liverpool, Lancashire, engineer, for certain improvements in steam-boilers, and in the construction, composition, and manufacture of bearings, steps, and other rubbing surfaces of steam-engines and other machinery, and also for a method of lubricating the same. June 18.

Lawrence Hill, junior, of Glasgow, engineer, for an improved brake for railway carriages. June 19.

David Henderson, of London Works, Renfrew, Renfrewshire, civil engineer, for certain improvements in cranes. June 19.

NOTES AND NOTICES.

Malleable Glass Rediscovered.—The *Mercure Ségusien* speaks of a marvellous invention which has come to light within the walls of Saint-Etienne—the production of a sort of glass as malleable when cold as while red-hot. The *Moniteur des Arts* says: "This new metal, which, ere long, will be of more value than gold, and which the inventor has called *Silicon*, is of a white colour, very sonorous, and as brilliant and transparent as crystal. It can be obtained, with equal ease, opaque or coloured; combines with various substances, and some of these combinations produce shades of extraordinary beauty. It is without smell—very ductile, very malleable; and neither air nor acids affect it. It can be blown like glass, melted, or stretched out into long threads of perfect regularity. It is very hard, very tough, and possesses the qualities of molten steel in the very highest degree."

Steam and the Screw as auxiliaries to Sailing Vessels.—Whilst so much attention is being drawn to screws as a substitute for paddle-wheels by the arrival of the *Great Britain* from Bristol, it may not be uninteresting to learn that Liverpool is not behind other ports in promoting objects of a similar nature. Four iron vessels, of various dimensions, with screw propellers, are now building under the directions of Mr. Grantham, consulting engineer. These vessels vary from about 300 to 1,000 tons, with engines of from 50 to 150 horse power. They will be fully rigged, and are all intended for the highest rate of sailing. On account of the greatly increased capacity for stowage in iron ships, the amount of cargo, independent of the space for the engines and coals, will be equal to that carried by timber-built vessels of the same external dimensions. The propellers in the cases here referred to are to be worked on a different principle to those hitherto constructed—the engines will be connected direct to the propelled shaft, causing the engine and screw to make an equal number of revolutions; by these means all spur wheels or bands are avoided, the machinery is much simplified, and kept nearer to the bottom of the vessel, an object of great importance in sailing vessels. Mr. Grantham obtained a patent, about three years ago, for this mode of working the screw propeller, at which time he applied it to a small vessel, which many of our readers will recollect having seen skimming with great velocity about the river. Mr. Peter Cato, and Messrs. James Hodgson and Co. have contracted for the vessels, some of which are in frame; and Messrs. Fawcett, Preston and Co. and Messrs. Bury, Curtis and Kennedy, have contracted for the engines.—*Gore's Liverpool Advertiser.*

East India Carpets.—"In looking over a Bombay paper the other day, I observe that Indian cottons, from the shortness and roughness of the staple, are only fitted for the lowest kinds of yarns and for coarse cloths; and I therefore would suggest one kind of manufacture—which does not, I believe, exist in England—of cotton, which would consume, I think, a vast quantity of the low cottons of India. If you don't take these cottons, we must lose considerably, and, if you can't make fine cloths of them,

why not make carpets? There are many kinds of carpets made of cotton in India—stout, serviceable, handsome things; generally, they are termed 'seringee.' These are of all sizes, from the small one, 7 feet by 3, which every man possesses, to enormous ones for rooms and halls. These are generally striped, red and blue, or three shades of blue, sometimes woven into patterns; and I have often thought how useful they would be in England, these coarse kinds, for the poorer classes, for bedrooms, &c. Again, what beautiful designs might not be manufactured by the skill of English workmen,—how large a quantity of small ones for individuals, or large for halls, might not be made for exportation to Africa, South America, and even India! At Wurungole, in the Nizam's country, beautiful carpets of the same description as Turkey—that is, with a nap raised—are made of cotton, and are far more beautiful, though more expensive, than woollen made at the same place: they wash and wear beyond belief. Surely this might be tried in England, and anything which would raise the consumption of the short staple cottons of India would be a benefit to her. Anything England can do, in fact, to increase or bring out her capabilities of produce, benefits the country and herself; and to this should the greater exertion of Government be continually maintained both in England and here."—*Correspondent of the Times.*

Chinese Flax.—Messrs. Hargreaves, Brothers, flax-spinners and power-loom linen manufacturers, of this town, called at our office a few days ago, and exhibited a sample of Chinese grass. This article is represented as possessing all the qualities of flax, but in a higher degree than any other known to our spinners or manufacturers, surpassing the best qualities in strength, fineness, and length of staple. These gentlemen also showed us a sample of fine linen manufactured by them from this article, which greatly resembled French cambric, but with a more silky appearance. It would appear that the Chinese grass can be supplied in *unlimited quantity*, and if that should be the case, it must be a subject for congratulation that an article of such large consumption in this country should be presenting itself as another exchangeable commodity for our manufactures, the rapidly extending consumption of which throughout China seems to be limited only by the means which they possess of making a suitable return for them.—*Leeds Mercury.*

Speed on Railways.—A return has just been published of the weight and speed of the express trains on several lines, from which we select the following:—Brighton averages 30 tons, performs 50 miles in 1 h. and 27 m., or 34 miles per hour, including stoppages; the Northern and Eastern, 27 tons, 32½ miles, 45 miles per hour; South-Western, 33 tons, 78 miles in 1 h. and 57 m., or 40 miles per hour; the Birmingham, 27½ tons, 112½ miles in 2 h. 55 m., or 38 miles per hour; South-Eastern, 35 tons, 67 miles in 2 h. 28 m., or 28 miles per hour; the Great Western, 76 tons, 194 miles in 4½h., or 42 miles per hour, and one train has kept the same time with 94 tons.

Mr. Armstrong's Colossal Hydro-Electric Machine.—As an illustration of the power of this machine, Mr. Armstrong stated at the late meeting of the British Association, that it had fully charged a battery containing thirty-three square feet of coated surface upwards of sixty times in a minute. He also mentioned, that by interrupting the electric current and causing it to pass through the thin wire coil of Callan's apparatus for inductive effects, he had obtained a secondary current in the thick wire coil, answering in all respects to an alternating voltaic current, and sufficient to occasion a permanent, though slight scintillation of two pieces of steel attached to opposite ends of the wire, and rubbed against each other.

The Paddle Wheel and Screw again.—The *Times'* reporter of the last Royal progress, gives the following account of a trial between the *Victoria and Albert* yacht, and her tender the *Fairy*, on the passage on Saturday last, from Portsmouth to the Isle of Wight. "The *Fairy* screw tender followed the Royal yacht, which, on passing the *Hibernia* at Spithead, made signal to her small consort to 'get up her steam—full power,' and try her rate of speed with the *Victoria and Albert*, which was accordingly done, and a trial of speed between the two vessels commenced, but the *Fairy* did not draw upon her larger consort, and from the time the signal was made up to the end of the voyage the *Fairy* had lost full a mile." Another similar trial took place on the Wednesday following, from Cowes to the Needles, when the *Fairy* was again left far in the rear."

Consumption of Sulphuric Acid.—It is no exaggeration to say, we may fairly judge of the commercial prosperity of a country from the amount of sulphuric acid it consumes. Reflecting upon the important influence which the price of sulphur exercises upon the cost of production of bleached and printed cotton stuffs, soap, glass, &c. and remembering that Great Britain supplies America, Spain, Portugal, and the East, with these, exchanging them for raw cotton, silk, wine, raisins, indigo, &c. &c. we can understand why the English Government should have resolved to resort to war with Naples, in order to abolish the sulphur monopoly which the latter power attempted recently to establish. Nothing could be more opposed to the true interests of Sicily than such a monopoly; indeed had it been maintained a few years, it is highly probable that sulphur, the source of her wealth, would have been rendered perfectly valueless to her. Science and industry form a power to which it is dangerous to present impediments. It was not difficult to perceive that the issue would be the entire cessation of the exportation of sulphur from Sicily. In the short period the sulphur monopoly lasted, fifteen patents were taken out for methods to obtain back the sulphuric acid used in making soda. Admitting that these fifteen experiments were not perfectly successful, there can be no doubt it would ere long have been accomplished. But then, in gypsum (sulphate of lime), and in heavy-spar (sulphate of barytes), we possess mountains of sulphuric acid; in galena (sulphate of lead), and in iron pyrites, we have no less abundance of sulphur. The problem is, how to separate the sulphuric acid, or the sulphur, from these native stores. Hundreds of thousands of pounds weight of sulphuric acid were prepared from iron pyrites, while the high price of sulphur consequent upon the monopoly lasted. We should probably ere long have triumphed over all difficulties, and have separated it from gypsum. The impulse has been given, the possibility of the process proved, and it may happen in a few years that the inconsiderate financial speculation of Naples may deprive her of that lucrative commerce. In like manner Russia, by her prohibitory system, has lost much of her trade in tallow and potash. One country purchases only from absolute necessity from another, which excludes her own productions from her markets. Instead of the tallow and linseed oil of Russia, Great Britain now uses palm oil and cocoa-nut oil of other countries. Precisely analogous is the combination of workmen against their employers, which has led to the construction of many admirable machines for superseding manual labour. In commerce and industry every imprudence carries with it its own punishment; every oppression immediately and sensibly recoils upon the head of those from whom it emanates,—*Liebeg.*

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No.166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1147.] SATURDAY, AUGUST 2, 1845. [Price 3*d.*

Edited by J. C. Robertson, No. 166, Fleet-street.

JOHNSTON'S SHEET-WATER SPACE BOILER.

Fig. 1.

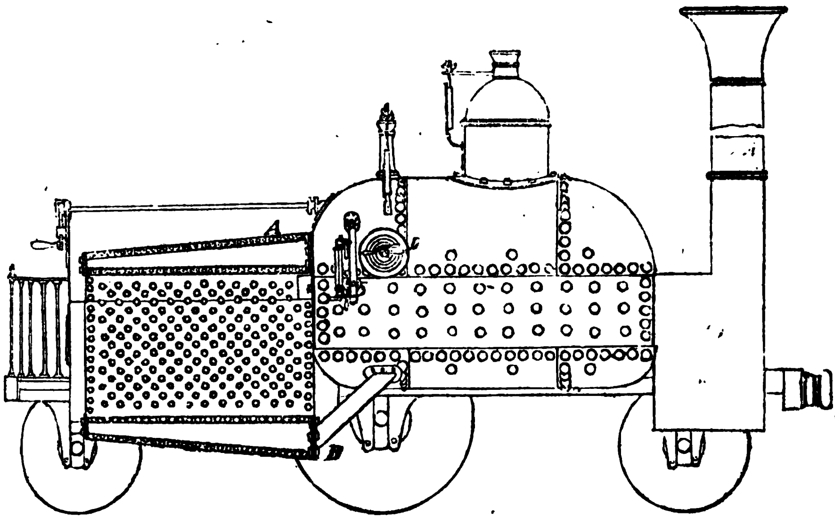


Fig. 3.

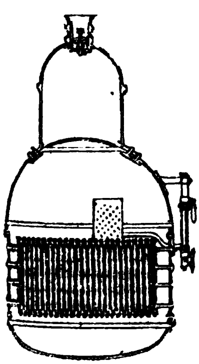


Fig 4

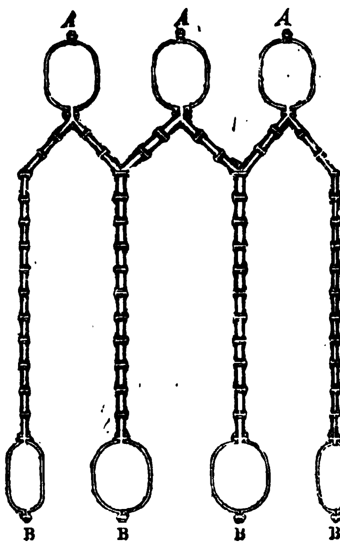
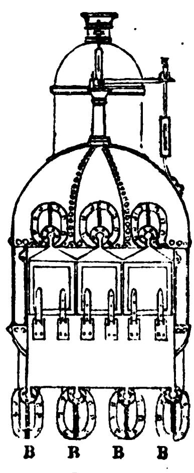


Fig. 2.



DESCRIPTION OF A LOCOMOTIVE SPACE BOILER, ON THE PATENT PLAN OF MR. JAMES JOHNSTON, OF WILLOW PARK, GREENOCK. BY THE INVENTOR.*

FIG. 1 is a side elevation of the boiler. A B is the furnace, L is one of Hosking's water gauges. D, the smoke-box, is made of extra length, in order to give greater effect to a practice which has been in use for two or three years in some of the locomotives, both on the English and Scotch lines, viz., the insertion of a plate or damper in the smoke-box, in such a manner that the products of combustion are made to pass beneath the lower edge of the plate previous to their getting into the chimney. I first saw this practised in 1842, in the locomotives on the Glasgow and Greenock railway; but it has not yet come into general use, although a saving of fuel is effected by it.

Fig. 2 is a front elevation of the boiler.

Fig. 3 is a cross section, through the body of the boiler.

Fig. 4 is a cross section through the three furnaces.

Figs. 5 and 6 are separate sketches of the pieces of metal which close up the ends of the sheet-water spaces between the flues.

The body of the boiler is 6 feet in length, and through it there pass twenty-seven chambers or flues, as shown in fig. 3. Between each of these flues there is a sheet-water space, ½ in. wide, 2 ft. deep, and 6 ft. in length. The outer flue on each side of the boiler (as indicated by the dark shading) is filled up with soot, or any other good non-conductor of heat. This is done on purpose to prevent the heat acting on the two large water spaces called descending water spaces, which are situated between the soot-filled flues, and the external casing of the boiler.

The superiority of this kind of boiler depends on the mass of water within it being divided and kept in two different states or conditions. The joint area of a cross section of the two descending water spaces, is rather greater than the joint area of the cross sections of all the sheet-water spaces between the flues and around the furnaces.

There are two divisions of the water, viz., the descending water spaces, and the ascending water spaces. As to the condition of the water in those two kinds of spaces, I have already stated that no heat is allowed to act on the descending water spaces; therefore, the water in those spaces is in the state technically termed solid; that is, there is no steam amongst it. Now as the sheet, or ascending water spaces, are acted on by the fire, steam will be formed in them. Therefore, in the two kinds of water spaces, we have water in two different states or conditions; in the descending spaces it is solid; in the ascending spaces, it is continually being converted into steam; and as steam is 1728 times lighter than water, it is evident that the water in the descending spaces will rush down, and displace the steam from the ascending spaces, as the two kinds of water spaces have free communication with each other at top and bottom.

B B, figs. 1, 2, and 4, are the conductors which convey the descending current of water to the sheet-water spaces of the furnaces. A A, figs. 1, 2, and 4, are the conductors which convey the steam and surplus water from the water spaces of the furnaces into the interior of the boiler.

The advantages that are gained by the powerful currents of water that are continually rushing up the sheet-water spaces are as follows:—

First. The bubbles of steam are removed from the plates of the boiler the instant they are formed, and therefore the plates of the boiler are kept cool, and cannot be injured although the fire be urged to the utmost.

Second. The formation of deposit is prevented, owing to the plates of the boiler being kept cool.

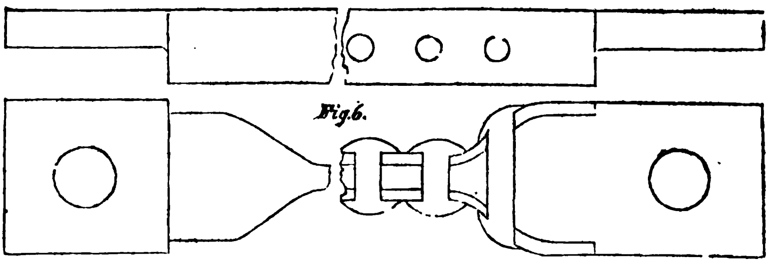
It is the overheating of the plates of the common kinds of boilers which causes the deposits to form on them, owing to the soluble bicarbonate of lime being converted by the heated plates into the insoluble carbonate.

Third. Fuel is saved, owing to the plates being cool, and consequently in a fitter condition to receive heat than when over-heated, as is the case in common boilers.

Fourth. In consequence of the currents passing through the sheet-water

* For some previous remarks on the principle of this boiler, see p. 21 of our present volume.

Fig. 5.



spaces, these spaces can be made of much smaller dimensions than the water spaces of other boilers; and, consequently, boilers made on this plan are of less bulk and weight in proportion to their power than any boiler hitherto invented.

The boiler represented in the accompanying engraving is intended for a locomotive to run on the narrow gauge railways. It has 750 square feet of heating surface in the flues, 135 square feet of heating surface in the furnaces, and 20½ square feet of fire-grate; that is, 4 square feet more fire-grate, and 75 square feet more heating surface in the furnaces, than there is in the furnace of the large locomotives that work the incline on the Edinburgh and Glasgow railway.

In consequence of the current in these boilers being produced by the difference in weight between the contents of the descending and ascending water spaces, it is evident that anything which would increase this difference would increase the rapidity of the current throughout the boiler. For this purpose I insert in these boilers the feed at the top of the descending water spaces, but under the surface of the water, so that the cold feed cannot affect the steam in the steam-chamber. In consequence of this arrangement, the currents are accelerated, owing to the cold feed water increasing the density of the water in the descending water spaces. If the cold feed were inserted at the bottom of the boiler, under the ascending water spaces, or at the lower part of the furnace, the current throughout the boiler would be diminished, as the cold water, if inserted at these places, would tend to equalize the weight of the contents of the ascending and descending water spaces.

The following is an extract from the report of a committee of the Franklin Institute, appointed to enquire into the cause of the explosion of the *Richmond* locomotive in the United States:—

"The large engines foam so much, especially when new, that every cock in the upper part of the boiler will indicate water, while the water spaces are filled with dry steam. In this case the gauge-cocks become worse than useless—they are actually deceptive; while the dangerous state of things around the fire-box requires no comment. Surely our ingenious mechanics will not be at a loss to contrive a remedy for this defect; and in view of this, the Committee would respectfully invite their attention to the new form of boiler devised by Mr. Johnston, which involves a principle, as it appears to the Committee, *perfectly fitted to meet the case.*"

J. J.

GEOMETRICAL EXTRACTION OF THE SQUARE ROOT.

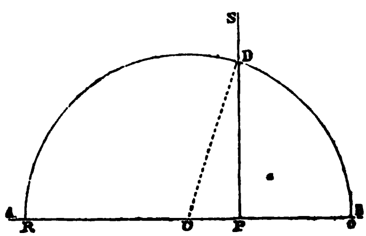
Amongst the numerous subjects connected with mechanical enquiries, there is no operation that more frequently requires to be performed than the extraction of the square root; yet, singular as it may appear, there is not a rule in the whole compass of arithmetic, of which the nature and application are less understood by the generality of practical men. This may be attributed to the circumstance, that the *rationale* of the process is of too abstract a character to come within the comprehension of the mere arithmetician; a position that will readily be admitted, when it is considered that the foundation of the rule cannot be traced without some knowledge of the elementary principles of algebra, the operation itself being nothing more than the analysis of an algebraic binomial product.

It is true that tables of the squares and square roots of numbers have been computed to a sufficient extent, and with a degree of precision beyond anything that can ever be required in actual practice; but then such tables are not at all times accessible; and besides, cases may frequently occur where they do not directly apply. On all such occasions it is desirable to possess some rule of easy application, whereby to approximate to the root of any number proposed, and to serve as a check on the result obtained by the regular or common rule, when the operator is not sufficiently conversant with the subject, as to place an implicit reliance on his own performances. It is a rule of this nature that we now propose to supply, requiring no further knowledge of elementary geometry, than how to raise a perpendicular, and describe a circle.

It is rather surprising, that in books of arithmetic and mensuration, where the use of the square root is taught, the method of approximating to the numerical value of the root by a geometrical construction should never be adverted to. There are several propositions in Euclid's Elements of Geometry from which the process may be inferred; but we are not aware that they have ever been made available for that purpose, either in text books for schools, or in books that are expressly designed to guide the operations of practice. The roots obtained in this way, when considered merely as geometrical magnitudes, are rigorously accurate; but when referred to numerical values measured from a scale, they are only approximative, and the degree of approximation is more or less accurate, according to the delicacy of the instruments, and the dexterity with which the process is performed. One of Euclid's propositions from which the operation may be inferred is the 14th of the second Book, where it is required "*to describe or make a square equal to a given right-lined figure.*" Now, it requires no great stretch of judgment to perceive that the side of this square is nothing else than the square root of the quantity by which the area of the right-lined figure is expressed; and, consequently, the process of determining an equal square is nothing else than the geometrical extraction of the square root; for it is only the side of the square, and not the square itself that the process determines.

When a number is proposed, of which it is required to approximate to the square root, we have only to consider that number as an area equivalent to the right-lined figure in the proposition, and then the side of an equal square will be the root of the number given. The operation is performed in this way:—the proposed number is divided into any two factors, of such convenient magnitudes as are suitable to the size of the paper on which the figure is to be delineated. It is of no consequence, in other respects, what factors be taken, provided that their product is precisely the same as the given number; but the nearer the factors are to an equality, the better; indeed, if they happen to be equal, either of them is the root sought, and in that case no construction is necessary; but when they are unequal, as will generally happen, draw the straight line A B,

Fig. 1.



of any length at pleasure, and in it take any point, P, at which erect the perpendicular P S, produced as far as necessary; then, from the point P, and in the direction towards A, set off P R equal to one of the factors into which the given number has previously been divided, the other being set off from P towards B, and falling in the point Q. Bisect Q R in C, and on C as a centre, with the distance C R or C Q as radius, describe the semicircle R D Q, meeting the perpendicular P S in D; then is P D the side of the square, or the root required. And this is rigorously correct, when considered geometrically, but only approximative when applied to a scale for numerical valuation.

Now nothing can be more simple than the above process; and every workman is sufficiently acquainted with the use of his instruments to be able to erect

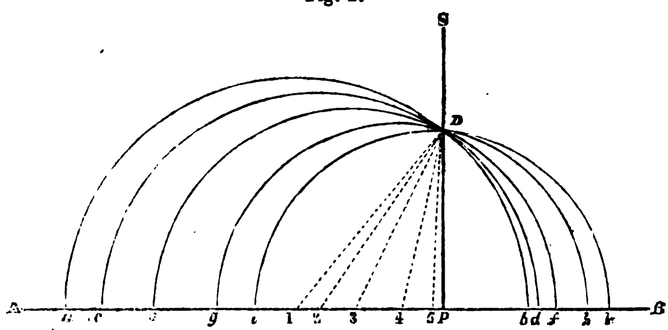
the perpendicular P S, and describe the semicircle R D Q; and since this in every case is all that is required after the given number is separated into its factors, practical men will find it to their advantage to render themselves familiar with the process of construction; and if they will only take some pains in taking off the numbers, and use good instruments, the results in general will be more than sufficiently accurate for every practical purpose.

We shall illustrate the principle by an example wherein the number whose root is required is separated into several pairs of factors. This is a favourable case for showing the general nature of the construction, as the result will be the same whatever factors be taken; and thus it will be seen that no difficulty will be encountered in separating the number in a proper way.

Example.—Let it be required to approximate to the square root of 360, by a construction similar to that above exemplified.

Now 360 is divisible into several pairs of factors, some of which are very convenient for the purpose of delineation and others not, in consequence of the space that they would occupy on the paper, if taken from a scale of such dimensions as to render them appreciable; the several pairs of factors are as follows, viz.: 2, 180; 3, 120; 4, 90; 5, 72; 6, 60; 8, 45; 9, 40; 10, 36; 12, 30; 15, 24; and 18, 20—in all eleven pairs. It is, however, evident, that in a limited space, some of the first pairs are not convenient for construction, although in other respects they are equally so with the rest; we will therefore perform the process with the last five pairs 9, 40; 10, 36; 12, 30; 15, 24, and 18, 20; the last pair being nearly equal, shows that the root is somewhere between them, being greater than 18 and less than 20. Here follows the construction.

Fig. 2.



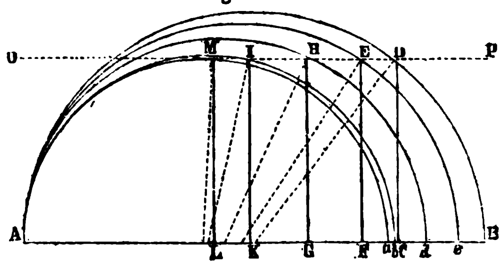
Draw the straight line A B, fig. 2, of any convenient or indefinite length, in which assume any point, P, at pleasure; at the point P thus assumed, erect the perpendicular P S, which can be produced as far as may be required. Then from the point P as an origin, and in the direction P A, towards the left hand, set off from a scale of equal parts, the distances, P *a*, P *c*, P *e*, P *g*, and P *i*, respectively, equal to the series of greater factors 40, 35, 30, 24, and 20.

And from the same point P, but towards B on the right hand, set off the several distances P *b*, P *d*, P *f*, P *h*, and P *k*, respectively equal to the series of smaller factors 9, 10, 12, 15 and 18; then bisect the distances *a b*, *c d*, *e f*, *g h* and *i k* in the points 1, 2, 3, 4 and 5; and on these points as centres, with half the corresponding distances as radii, describe the semicircles as in the figure; these semicircles will all intersect the perpendicular P S in the same point D, so that P D shall be the square root of 360, the number proposed; accurately when viewed in its geometrical character, but approximatively when valued numerically by applying it to the scale of construction; by measurement it will be found as nearly as possible equal to 19, the square of 19 being 361 instead of 360; the calculated root is 18 973, &c., carried to any degree of exactness at pleasure.

This solution has been given on the supposition that the position of the point P is fixed, the corresponding factors originating there and extending on each

side of it along the line A B; this however is not a necessary condition, for all the factors may be made to originate at any other fixed point, in such a manner, that the position of the point of junction shall be variable. Thus, in fig. 3, let the several distances A C, A F, A G, A K, and A L respectively, be equal to the series of greater factors, all originating at the point A, and whose numerical values

Fig. 3.



are 40, 36, 30, 24 and 20; and let C B, F *e*, G *d*, K *b* and L *a* be the lesser series of factors, originating at the points C, F, G, K and L, and having their numerical values respectively 9, 10, 12, 15 and 18; then by bisecting the sum of each pair of factors, and with their halves describing the several semicircles A D B, A E *e*, A H *d*, A I *b* and A M *a*, it will be found that these semicircles intersect the perpendiculars C D, F E, G H, K I and L M, in the points D, E, H, I and M, all of which are equally distant from the straight line A B, or all subsisting in O P, which is parallel to A B, so that any one of the perpendiculars may be taken as the root of the proposed number 360; hence it appears, that any pair of factors into which any number can be separated, will give the square root of that number, but since some of the pairs are found more convenient for the purpose than others, it remains for the operator to select that pair which is likely to succeed the best. The two methods by which we have resolved the proposed numerical example, have only been carried out to show the generality of the process; but in practice one operation will always be sufficient, and in that case, the steps of the construction will be the same as those that we have described in delineating the first of the foregoing figures, where the mode of procedure is sufficiently obvious and the quantity of labour very trifling.

We have stated that there are several propositions in Euclid's Elements from which the process may be inferred; it is however unnecessary to specify them, as the one which we have quoted is the most directly applicable, and the only one in which the assimilation of figures is implied, this being the very circumstance that suggests the idea of quadrate evolution. The process itself is nothing more than finding a mean proportional between two given lines, a problem which is given in every book on practical geometry, and therefore well known; but the identification of the solution with the extraction of the square root, has not, to our knowledge, been pointed out, at least in such a way as to render it available to practical men, who may not be ready in applying the arithmetical process; and having done this is the only merit to which the present paper lays claim.

RAILWAY STATION CLOCKS—MR. VULLIAMY'S PAPER.

Sir,—I have read in your Journal an article concerning "Railway Clocks," by Mr. Vulliamy. With the first portion of it, in which the writer contends for uniformity of time all over England, and that that time should be Greenwich mean time, I believe the public will generally agree. The advice given respecting the best clocks for railway stations, &c., I did however expect would have been more of an original and instructive character than it is, coming, as it does, from so long established a vender of clocks. The whole of the information is, indeed, no more than is usually given to a customer on making a purchase. I am anx-

ious to impress upon persons interested in the improvement of clocks, that something more is required of them than an enumeration of well-known facts; and it is for this reason, that I propose (with your permission), to enter a little into the remarks contained in Mr. Vulliamy's paper.

Clocks, we are informed, must either have a weight or spring for the maintaining power, and the weight clock, of course, is recommended, with a seconds pendulum. Then we are informed, that the spring or gut-line may break, and that the new spring may be stronger or weaker, which will materially alter the time. These remarks only show that the art of clockmaking is still in its infancy, for there can be no doubt that the suspension spring may be so managed as to prevent any such variation. I have seen marine chronometers keep the same time with a spring one-third weaker than the proper spring. We are informed, that if the spring be a little stronger or weaker, it will cause a considerable alteration in the rate, and that the pendulum is thought by workmen to possess superior qualities to the balance: surely, if that is the case, it can be made subservient to the isochronal law. I have had silk lines in clocks that have lasted six or eight years, which, I think, is as long as clocks in general will keep going without cleaning. It would be absurd to think of employing half-second pendulum clocks, instead of weight clocks, with an idea of saving, as there is more work in the former, which the difference in the case of the weight can scarcely compensate. Now for the escapement: Graham's dead beat is the one most strongly recommended with all its thirst for oil, which alone sometimes causes it to fail in less than a year. The oil, I think, is sooner driven away from the acting part of the pallet in the above escapement than any other; it is likewise an escapement that possesses no control over a pendulum that may be deficient in adjustment, in long and short vibrations, which is a great consideration, as the cold thickens the oil, and the construction of the escapement drives it from the part that requires it. Is there not a recoil escapement that might be recommended? It has several advantages over the dead beat, such as the three following (or more perhaps): the oil cannot be driven on the repose part, and there remain of no use; the wheels are always in motion, which prevents some of that loss of power in the impulse from the oil after the clock has been going three or four years; and the escapement can be varied in construction to suit errors in the pendulum, which is of consequence. When we are told, for example, that a spring clock varies considerably, say ten minutes per week after cleaning, this must be from a disregard of adjustment in the suspension spring; it is proper to have adjustment for beat, and it is of consequence that it should be well made. Clocks ought likewise to have going ratchets. With respect to the dial, whether it is engraved or painted, silvered or gilt, or of any of the following dimensions, —6, 12, or 18 in. diameter,—it matters not, except to the parties who use it. Pinions are not very expensive, and I should think twenty shillings additional expense not worth considering in a concern like a railway.

The pendulum, we are further told, is a part of the clock on which its good performance mainly depends, and to which too much attention cannot be paid. Let me ask your readers what attention it has received from Mr. Vulliamy? Does he give us any fresh information? Does he hint at anything that might improve it? I should say he does not, when the antiquated wooden rod is all he can recommend. He makes no mention of any laborious endeavours made to perfect compensation-pendulums, or to bring them within the limit of what he terms "moderate expense." The suspension spring ought to be, we are informed,—0·5, 0·6 of an inch in length. Is that rule given in consequence of its being more uniform in different arcs of vibration? Is there not considerable variation between the 0·5 and the 0·6 of an inch in isochronism? Is not the metal of the spring sometimes thicker at one part, or in other words, is it not used taper? And is it always tapered alike? These questions must be answered before any length for pendulum-suspension springs can be given to the world as of universal application. It is, in fact, deceiving the working clock-maker, who confides in the proposed length on the supposition that no person would issue to the world dimensions for a suspension spring, unless he could answer for the properties contained in the given length.

Again, as to the going weight—adjusting slides are recommended for the purpose of keeping the arc of vibration up to a given point. This is another proof that clocks are not scientifically made; otherwise diminution in the vibration would not alter the time. It is true, a continual decrease of vibration must eventually stop a clock, and this, I am afraid, will require considerable addition of weight to prevent, which again would produce another evil—increased friction, which oiling the pallets might obviate, instead of increasing the weight.

I remain, Sir,
Your obedient servant,
A "PINION OF EIGHT."

CURVE-LINED SOLIDS—THEIR VARIOUS SECTIONS.

Sir,—While the papers on "Centrobaric Mensuration" are before your readers, perhaps I may be permitted to suggest for consideration the *various sections* of the different *curve-lined* solids, thus brought into particular notice, and the projection upon a plan of such lines as would be produced by the intersections of the like and differing solids with each other. Let the enquiry be extended in the first instance to those solids formed by the generation of the circle or the right line, or both round a centre.

There is such a gradual connection or intimate relation between all the numerous curves of the very easiest description, and the conic section, that it is not unreasonable to suppose that the whole are sections, or projections of intersections of some other solids, gradually varying from the cylinder or cone, or in some other way related to them.

The cardioid, by different modes of generation, is the reciprocal of the ellipse; the ellipse is a conic section, the section of a cylinder, and the projection, and perspective representation of a circle. Then, in any of these, or any other respect, what is the cardioid?

But the cardioid by another mode of generation is the reciprocal of the cardioid.

Again, the cardioid is to the ellipse, what the conchoid is to the reciprocal of the conchoid.

In the other case, the cardioid is to its reciprocal cardioid, what the cissoid is to its reciprocal cissoid.

I am, Sir, yours, &c.
JOSEPH JOPLING.
29, Wimpole-street, July 22, 1845.

MR. NASMYTH'S STEAM HAMMER, PILE DRIVER, ETC., NOT NEW. INVENTED AND PATENTED BY MR. WM. DEVERELL FORTY YEARS AGO.

Sir,—On turning over an old volume of the Repertory of Arts (vol. ix., second series, p. 387) a few days ago, I was somewhat amazed at finding the specification for a patent, of which I send you a copy below, for a steam hammer, identical with Mr. Nasmyth's, patented so long ago as the year 1806, by a person named Deverell, who seems to have been fully alive to the importance of this principle of motion, and who describes or alludes to almost every conceivable variety of form or construction, and nearly every purpose or application possible for the steam hammer or blow to be used for. If I am right in my reading of this specification, it fully anticipates all that is contained in each of Mr. Nasmyth's subsequent patents for the steam hammer and its applications; and if so, leaves the making, vending, and using these important machines henceforth free to the public.

If this be so, Mr. Nasmyth will have nothing to complain of in hereafter reaping a limited harvest from inventions to which he can have no further right than as a second inventor, and thence without any claim to monopoly. And, indeed, any man who now-a-days conceives something which he thinks is new, and patents it without a rigid search as to prior patents or inventions identical with his own, *deserves* (we might almost say) to learn at his own cost that there are very few new things, if any, under the sun.

I am, Sir, your obedient servant,
LECTOR.

(*Copy.*)

"Specification of the patent granted to William Deverell, of Charles-street, Blackfriars'-road, in the parish of Christ Church, and county of Surrey, engineer, for certain improvements in the mode of giving motion to hammers, stampers, knives, shears, and other things, without the application of wheel, pinion, or any ro-

tative motion, by means of various powers now in common use. Dated 6th June 1806.

"To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I, the said William Deverell, do make known and describe my said methods of giving motion to the aforesaid things, and how the same is to be performed, as follows; that is to say, First, I raise steam in a boiler or steam-vessel, as in the common way. I have a steam cylinder, with a piston and rod in it; at the end of the rod that comes out of the steam cylinder is a hammer, either made fast to the rod by welding, or any other common way. The steam from the boiler or steam-vessel is let in underneath the piston by means of opening a cock or valve, or cocks or valves; the air at the top of the piston will then be compressed by means of the superior pressure of the steam underneath the piston. After the piston has been raised to a given height, there will be an opening made in the under side of the piston to a vacuum formed as in the common way; or otherwise the steam may be let out into the common air. The compressed air on the top of the piston will then drive down the hammer with a velocity equal to what it may be compressed. There may be a vessel partly full of water, the top of which is made to communicate with the cylinder. At the upper side of the piston, there should be valves or cocks, or some other proper contrivance, to adjust the water so as the air may be compressed as the velocity of the hammer may require. The hammer may be worked by steam, or some other spring that may answer the intended purpose, or by steam alone. The weight of the hammer may be made equal to the pressure of the steam, so as to work without springs. The weight of the hammer may be regulated as necessity requires, by taking one hammer off, and putting on another of a different size. The hammer may have a stilt to it, and the piston may be made fast to hammer or stilt as occasion may require; or otherwise, there may be a lever or levers. Either of these may be attached to the piston-rod, so as to give motion to the hammer or hammers, as more than one may be worked in this way. There may be hammers worked from both ends of the cylinder, as the piston-rod or ends may come out at each end of the cylinder; and the air may be compressed in the cylinder, or any other convenient vessel or vessels. The hammer or hammers may have motion given to them by the piston-rod, without being connected one with the other, by striking on the back part of the hammer stilt; or, otherwise, by lifting underneath the stilt, at the hammer end of the same; but this may be done in various other ways, not necessary here to be described.

The stampers may be worked in the same manner as the hammers. The method I make use of to work presses is as follows:—I have a lever, or compound levers, with one end of the lever or levers working on a fulcrum or joint, with the piston-rod attached to one end of same lever or levers; and as the steam is let in, the piston from the steam boiler will lift or compress the lever or levers as may be required. The lever or levers may be fixed so as to work perpendicularly, horizontally, or in any other required direction. The shape, size, or form of the press may be varied agreeably to existing circumstances. The knives may be made fast to the piston-rod, or any convenient thing connected with the piston-rod; or otherwise, the piston-rod may be made fast to the lever or levers, or knife or knives; or other levers may be used if found necessary, so as to work the knives; but these knives may be fixed in various other ways, so as to chip fustic, logwood, and other woods, and may also be fixed to any proper thing which it will work to, and again by the piston-rod being attached to some part thereof. The shears may be worked by the piston-rod being attached to the end of the shears' lever; or there may be a second lever, or more if required, so that the piston-rod may be attached to some convenient part thereof, in order to give motion to the shears. I also apply the above mode for the working or giving motion to bellows. In that case, the piston-rod may be attached or made fast to the back part of the bellows; or separate levers may be made use of, which may be made fast to any part of the bellows.

"In the above I have given a plain and clear description of the nature of my invention, and what I conceive will be fully sufficient to enable any intelligent workman to carry the same into complete effect.

"In witness whereof," &c.

BRITISH ASSOCIATION—CAMBRIDGE MEETING, 1845.

[Some further selections from the published Reports of the Proceedings.]

Strength of Stone Columns.

A report of experiments on this subject by Mr. E. HODGKINSON was read. The columns were of different heights, varying from 1 inch to 40 inches; they were square uniform prisms, the sides of the bases of which were 1 in. and 1¾ in., and the crushing weight was applied in the direction of the strata. From the experiments on the

two series of pillars it appears that there is a falling off in strength in all columns from the shortest to the longest; but that the diminution is so small, when the height of the column is not greater than about twelve times the side of its square, that the strength may be considered as uniform, the mean being 10,000 lbs. per square inch, or upwards. From the experiments on the columns one inch square, it appears that when the height is 15 times the side of the square the strength is slightly reduced; when the height is 24 times the base, the falling off is from 138 to 96 nearly; when it is 30 times the base, the strength is reduced from 138 to 75; and when it is 40 times the base, the strength is reduced to 52, or to little more than one-third. These numbers will be modified to some extent by the experiments in progress. In all columns shorter than 30 times the side of the square, fracture took place by one of the ends failing; showing the ends to be the weakest parts; and the increased weakness of the longer columns over that of the shorter ones seemed to arise from the former being deflected more than the latter, and therefore exposing a smaller part of the ends to the crushing force. The cause of failure is the tendency of rigid materials to form wedges with sharp ends, these wedges splitting the body up in a manner which is always pretty nearly the same; some attempts to explain this matter theoretically were made by Coulomb. As long columns always give way first at the ends—showing that part to be the weakest—the material might be economized by making the areas of the ends larger than that of the middle, increasing the strength from the middle both ways towards the ends. If the area of the ends be to the area in the middle as the strength of a short column is to that of a long one, we should have for a column whose height was 24 times the breadth, the area of the ends and middle as 13·766 to 9·595 nearly. This, however, would make the ends somewhat too strong; since the weakness of long columns arises from their flexure, and increasing the ends would diminish that flexure. Another mode of increasing the strength of the ends would be that of preventing flexure by increasing the dimensions of the middle. From the experiments it would appear that the Grecian columns, which seldom had their lengths more than about ten times the diameter, were nearly of the form capable of bearing the greatest weight when their shafts were uniform; and that columns tapering from the bottom to the top were only capable of bearing weights due to the smallest part of their section, though the larger end might serve to prevent lateral thrusts. This last remark applies, too, to the Egyptian columns, the strength of the column being only that of the smallest part of the section. From the two series of experiments, it appeared that the strength of a short column is nearly in proportion to the area of the section, though the strength of the larger one is somewhat less than in that proportion.

Prof. Challis inquired whether Mr. Hodgkinson had found the columns to give way chiefly in the direction of the cleavages of the stone? Mr. Hodgkinson replied that he had; and that hence two pieces of the same size and shape of stone cut out of the same block, required very different forces to crush them across the grain from what they did with it.

Improved Method of taking Positive Talbotypes (Calotypes).

In the method now in use the face of the negative Talbotype is placed directly upon the side of the paper which has been brushed over with a solution of nitrate or ammoniacal nitrate of silver, and which is to receive the positive picture. In strong sunlight the picture is thus taken very quickly; but there is a roughness in the shades, owing to the formation of black specks, which destroys the softness of the picture, and in portraits gives a disagreeable harshness to the human face. In order to remove this defect, Sir David Brewster first interposed thin plates of glass, with their surfaces sometimes ground and sometimes polished; but, though the divergency or diffusion of the light, passing through the *negative* picture, produced great softness in the *positive*, yet the outlines were too indistinct, though the Talbotypes looked very well, when placed at a distance. Sir David now informed the meeting that he had tried the effect of interposing a sheet of writing-paper, without the water-mark and of uniform texture. The result of this experiment fully answered his expectations. The diffusion of the light thus occasioned shaded off, as it were, all the sharp lines and points, and gave a high degree of softness to the picture. The effect was even improved by interposing *two* sheets of clean paper; and with a very bright meridian sun, he found that *three* sheets may be used with advantage. A similar effect may be obtained, in a smaller degree, by placing the *back* of the negative upon the positive paper, so as to cause the light to traverse the thickness of the negative, and this may be combined with one or more sheets of clean paper. This, of course, will be appropriate only with portraits; and it has the advantage (sometimes required) of making the figure look another way. To those who see the experiment above described for the first time, the effect is almost magical; when the negative is removed, we see only a blank sheet of white paper, and

our surprise is very great when, upon lifting this sheet, we discover beneath it a perfect picture, which seems as it were to have passed through the opaque and impervious screen. Sir D. Brewster exhibited specimens of portraits produced in this manner, and also specimens produced by the transmission of light through two perfectly coincident negatives of different degrees of strength; together with specimens of positives, produced by placing the positive paper between two perfectly coincident negatives, and acted upon by light incident on both sides of the picture. Sir D. Brewster mentioned some unexpected theoretical results, which these experiments indicated, but which required further investigation.

The Iron Trade and Iron Shipping.

Mr. WATT read a report on the Iron-trade in Scotland, from which it appeared that at the present moment there are extensive new iron-works erecting in Scotland, especially in Ayrshire and in Renfrewshire. At several of the old works considerable additions are being made to the number of furnaces now at work. The increase in the annual quantity of pig-iron smelted in that country in April, 1845, amounts to 37·4 per cent. And there is every appearance that, before another year expires, a similar increase will be made in the amount of iron produced in Scotland. There are 2,047,000 tons of coal raised annually in Lanarkshire.

At the conclusion of Mr. Watt's paper, Mr. PORTER mentioned the following facts respecting the iron-trade in England. Sir J. Guest, of Dowlais Works, in evidence before Import Duties Committee 1840, stated that the iron made at the beginning of this century amounted to . 150,000 tons.

In 1806	. .	258,000 „
In 1823	. .	452,000 „
In 1825	. .	581,000 „
In 1828	. .	703,000 „
In 1835	. .	1,000,000 „
In 1836	. .	1,200,000 „
In 1840	. .	1,500,000 „

Mr. Porter further said, that Mr. Jessop, of the Butterley Works, estimated the annual produce in Great Britain, exclusive of Ireland, in 1840, at 1,396,400 tons, and that the quantity of coal used for smelting that quantity was 4,877 tons, besides 2,000,000 tons for converting into wrought iron. To illustrate the importance of iron steamers, he could state that the *Aaron Manby* iron steam-boat, built in 1820 at the Horsley Iron-works, has been in use ever since, and the repairs to her hull have not altogether cost 50*l.* in those twenty-five years. A small iron steam-boat has been plying upon the Shannon since 1825. She is still in good condition. The number of iron steam-boats launched since 1830 is more than 150. The steam navy of the East India Company consist, in a great part, of iron; 25 are now in use in India.

*Mr. Nasmyth's Steam Pile Driver.**

Dr. GREENE read a letter received from Mr. Nasmyth, dated Devonport, where the machine is now in full action for the embankment to be erected there, to keep out the sea and form a wet dock. Mr. N. states, that at the first trial with a part of the machine it drove a pile 14 inches square, and 18 feet in length, 15 feet into the ground with 20 blows of the monkey, the machine then working 70 strokes a minute; the ground was a coarse ground imbedded in a strong tenacious clay. He describes it as going far beyond what he had dared even to hope for, and that it is truly laughable to see it stick vast 66-ft. piles into the ground as a lady would stick pins into her pincushion. The entire of the operations required to be performed on each pile from the time it is floated alongside of the stage until it is embedded in the solid foundation of slate-rock is only 4½ minutes. The great stage which carries the machine, boiler, workmen, and everything necessary, trots along on its railway like a wheelbarrow and moves on, the diameter of a pile, the moment it has finished the last. It picks the pile up out of the water, hoists it high in the air, drops it into its exact place, then covers it with the great magic cap, which follows it as it sinks into the ground, then thump goes the monkey on its head, jumping away 70 jumps a minute. At the first stroke the pile sank 6 feet, its advance gradually diminishing, until in the hard ground above the solid slate rock it was reduced to 9 inches. Nothing can better prove the superiority of the principle of this invention, of getting the momentum by a heavy weight moving with small velocity over the same momentum, as got, on the old principle, by a light weight moving with great velocity, than the state of the heads of the piles as driven by each process. Dr. Greene drew attention to a sketch of two heads of piles, one 56 feet long driven by a monkey of 12 cwt., falling from a great height, and making only one blow in five minutes, and requiring 20 hours to drive it; this, though protected by a hoop of iron, is so split and shattered on the head, that it would require to be re-headed to drive it any further. The other, although 66 feet long, was not even supported by an iron hoop,

* See, as to the originality of this invention, a preceding article, p. 72.

and the head is as smooth as if it were dressed off with a new plane. It was driven with a hammer 50 cwt. and only 3 feet fall, making 70 blows a minute.

Railway Gradients.

Mr. FAIRBAIRN read a communication on this subject, the object of which was to show the importance of economizing the first cost of railways, by introducing steep gradients in difficult districts, whereby the expenses attendant on tunnels, viaducts, and lofty embankments, would be avoided; whilst the author showed that the desired speed might be obtained by increasing the power of the locomotive. Originally, cylinders only of 10-inch diameter had been used, but at the present time, the engines are furnished with cylinders of 14, 16, and 18 inches diameter. The *maximum* speed which had been originally calculated on, was 10 miles per hour, whereas, at the present time, the ordinary speed on the Great Western, with first-class gradients, is 40 miles. The paper was illustrated by many experiments which had recently been made with regard to gradients on the Manchester and Leeds Railway.

THE LONDON FIRE BRIGADE AND THE SUPPLY OF WATER AT FIRES. NOTES ON MR. BADDELEY'S REPORT OF "LONDON FIRES IN 1844," AND HIS "STRICTURES" ON A PAPER BY MR. BRAIDWOOD. (MECHANICS' MAGAZINE, NOS. 1127, 1130, 1131, AND 1133). BY A FIREMAN.

[Continued from p. 56.]

The subject of the "Origin of Fires," furnishes Mr. Baddeley with a whole chapter of aspersions on the Fire Brigade. The same men whose fitness for all the duties entrusted to them was year after year praised by him beyond measure, are now all at once become the objects of his equally measureless detraction. The subject (Origin of Fires) we are told is one which requires *more philosophy* for its unravelment than is possessed by those *on whom this employment falls.* "*Our* Fire Brigades seldom show to so little advantage as in elucidating the cause of fire *when involved in any kind of difficulty;* their *superficial* method of investigation seldom penetrating far enough to probe out deeply hidden causes. *Prejudice* has also been apt to exert its baneful influence," &c., &c.—*Mech. Mag.*, No. 1127, p. 182. Again:

"The *systematic* regulations of the Fire Establishment frequently compel fires to be reported before the *cause can possibly be ascertained;* and although subsequent investigation may clearly elucidate the matter, *no correction of the report takes place.*"—*Mech. Mag.*, No. 1127, p. 182.

If there were any truth in what Mr. Baddeley here tells us of the practice of the Fire Brigade, there might be some ground for his unfavourable opinion of them (*quoad hæc*); but *there is no truth* in it. The "systematic regulations of the Fire Establishment" require that every morning reports shall be sent into the different offices of the fires which have occurred during the preceding twenty-four hours, and these reports being almost always drawn up in haste are necessarily imperfect, and with respect to nothing so much so as the causes of the fires, which demand, of course, time and leisure for their investigation. But another of the "systematic regulations," which I can hardly suppose Mr. Baddeley to be ignorant of, is, that a general record of the fires and their causes shall be made up at the head-office, not only from the information contained in these daily reports, *but from all other information subsequently acquired.* Should any mistake have been made in the first instance (as often happens), it is corrected; should any new light have been acquired, it is carefully treasured up. The entire course of procedure, in short, is directly the opposite of that which Mr. Baddeley (ignorantly or malevolently) imputes to the Brigade.

The "*manner*" of the Fire Brigade reports is, according to our veracious critic, quite as faulty as the matter of them. It appears that Mr. Braidwood is in the habit of assigning fires to "*moral* causes" (the Italics are Mr. Baddeley's own) as well as physical; and to such causes, among others, as "working on Sundays"! Mr. Baddeley seems quite shocked at such excessive puritanism. Why he should call it a vice of "manner," however, I am rather puzzled to understand; if there is vice at all in the case, it is in the thing—the matter—the ascribing (*e.g.*) to Sunday labour what Sunday labour is alleged to have nothing to do with. Be it matter or manner, however, Mr. Braidwood is equally free from blame. "Moral causes" do exert a very direct and powerful influence on the frequency of fires, and working on Sundays, as much, perhaps, as any. Not on the

high ground that some may be disposed to take, that Sabbath-breakers are more likely than others to be punished by fire; but simply because the man who overtasks himself by working every day of the week, Sundays included, or who makes up by working on the Sunday for hours idly spent during the preceding days of the week, is likely to be less watchful, careful, and steady, than one who habitually abstains from labour on the appointed day of rest, and never gives up to dissipation those hours which belong to industry. Your man of "all hours" is proverbially a reckless man; one who is as likely to allow his pot as his passions to boil over.

Mr. Baddeley's remedy for all the fancied deficiencies of the Fire Brigade is, to hand over their functions to the City and the Metropolitan Police!

"Let us hope that Government will at once bring forward and carry into effect such a perfect and efficient system of Fire-police as will be creditable to the science of the country, and afford, as far as human efforts can accomplish, the utmost possible assistance to rescue both lives and property from fire, *unfettered by the chilling influences of calculating commercial policy.*"

* * * *

"To an efficient and well-organized Fire-police we must come at last."—*Mech. Mag.*, No. 1127, pp. 184—186.

Mr. Braidwood has contended, on the contrary, in the paper of his read before the Institution of Civil Engineers, that "to add to the numerous and varied duties of the police, that of firemen would only be to confuse them;" and there are few reflecting persons, I apprehend, who will not be disposed to agree with him. It stands to reason, that where there are peculiar duties to be performed, they will be best performed by one class or set of persons devoting themselves to them solely and exclusively. An excellent marksman with the musket or rifle may make but a sorry artilleryman; a rare bombardier, but an awkward light-horseman. Catching thieves and putting out fires are two as different occupations, requiring as different talents, as any two pursuits in the world. Besides, I have never yet heard it said, that the police of the metropolis have not, as it is, quite enough to do. Why, then, burden them with more?

Mr. Baddeley refers to the "Liverpool practice," as conclusive of the fallacy of Mr. Braidwood's objection to the union of the fire and police duties. I should have thought *Liverpool* would have been the last place that any person would have gone to, for an example of good management in regard to fires. For the number and destructiveness of its fires, no place, perhaps, is so famous; but I have yet to learn that it is famous in the fire way for anything else. Indeed, I have no doubt that it is in a great measure owing to that very union in Liverpool of the functions of fireman and policeman, which Mr. Baddeley praises so highly, that it has suffered of late so much from conflagrations.

A Bill, it may be remembered, was brought in last year by the ministers, but withdrawn, "for the better prevention of damage by fire in the metropolis and its neighbourhood." The reason of its being withdrawn may not, however, be so generally known, or at least remembered. Here it is:—

"On the 16th of July, *I* presented a petition to the House of Commons, pointing out many of the incongruities and absurdities embodied in the proposed enactments, as well as the dangerous results that might be expected from the passing of so ill-considered a measure. *On the following day the Bill was withdrawn.*"—No. 1127, p. 183.

Most puissant yet modest Mr. Baddeley! He had but to nod his dissent to cause Sir James Graham and Lord Lincoln to pocket their bill, and beg he would say no more about it.

De mortuis nil nisi bonum is not, however, Mr. Baddeley's rule of action. He rails at the Bill as fiercely as if he and all of us had something very dreadful to apprehend from it. He expends all his wrath, however, on the mere details of the measure, and never once adverts to what I take to have been its grand fault, and the true cause (Mr. Baddeley's wonder-working petition notwithstanding) of its withdrawal. I refer to the heavy pecuniary burdens, which it would have imposed on parishes—heavy, I mean, in comparison with any benefit which could have been derived from it. Ministers found on enquiry at the Fire Brigade establishment that during the eleven years commencing with 1833, the total number of persons who lost their lives by houses taking fire was only 71, *and that of these not more than fourteen could have been saved by means of fire-escapes*, being at the rate of little more than one a-year.

To guard against this very trifling casualty, the Bill proposed to compel parishes to go to an expense in providing fire-escapes, and keeping them in constant readiness, which could not have amounted to less than 25,000*l.* a-year! Ministers hesitated, and well they might, to press so onerous a measure. If they had pressed it, I do not believe the parishes would ever have submitted to it.

(*To be concluded in our next.*)

P.S. In my last there was a mistake made (from a misreading of my MS.), which I take this opportunity of correcting. It was only in the case of the 3rd and 4th experiments, related at p. 53, that "both engines were worked by the same number of hands." In the 1st and 2nd, the Brigade engines was worked by 90 men. The Dock engine was said to have had 45 men all through.

RONALD'S PATENT SUGAR-BOILING APPARATUS.

Sir,—Your remarks in No. 1146, on the above apparatus and patent specification are, I think, perfectly just; but not so severe as they ought to have been.

I know something of sugar-making; I know something of steam—of evaporation; and I know *a good deal* of the patent laws—the disgrace of this country; and I hope thereby to enlighten Mr. Ronald on subjects which he does not appear so well acquainted with as he ought to be.

The title of his patent is, "*An apparatus* for boiling sugar-cane juice, and other liquids." (This you ought to have given with the specification.) Now it is well known to those versed in patent law, that the specification must agree with the title; if it describes or claims more than the title will allow of, it is bad, and would not be held valid in a court of law. Does Mr. Ronald's specification stand this test? No. By his rigmarole, or *corps de reserve*, he claims "*other modes* of accomplishing the said invention or objects;" and, among other reserves, "I reserve the right to drive or work any kind of machinery which I may apply to effect the object of my said patent (*query*, invention?—if it be one) by the force of boiling liquid." Preserve us! If the invention had been worth the trouble of even writing a specification for, (and to any person who may be induced to use it, I candidly believe it would not be worth even that,) the claim ought to have been simply for "*the apparatus described;* and that would have been better in law than all he has claimed.

His first claim states an utter impossibility, namely, that the heating power of pipes is greatly increased by admitting steam at two places instead of one; which is about equal to this: Mr. Reserve,—Mr. Ronald, I mean—puts a half-sovereign into each hand, and, holding them above his head, slips them down his sleeves, and *thereby* they come out at his back a couple of half-guineas; whereas, if he had dropped them both down *one* sleeve, they would only have come out a couple of farthings! Prodigious!

Mr. Ronald ought to know this, that steam contains a certain quantity of heat, and whether conducted by admitting it at two places or twenty, he cannot *thereby* increase its effect. Why is such a statement as the following inserted into such a specification?—"When the steam is admitted at one place only, a great deal of its heating power is exhausted before it reaches the farther end of the piping." Does Mr. Ronald imagine that sugar-boilers are so extremely ignorant as to require to be told such a thing? I however doubt, since he has made the statement, whether he can explain the reason of it! And can he explain why the sugar made by his apparatus, if any, is not of a better colour? or the cause of the colour of brown sugar? or if sugar is well drained *before* it is put on board, why it will not drain on the voyage?

The evaporation of liquids is a very simple matter. Mr. Ronald's apparatus however, does not appear at all likely to effect the purpose so well, so rapidly, or so clearly as many others that have gone before it. He ought to have borne in mind, that *rapidity* of evaporation depends on the vapour formed being carried off as fast as it is generated; this can be done by condensation, or by bringing a current of dry hot air in contact with it, as is well known and practised, and on plans so good, that nothing can be better.

I do *not* reserve the right to say more, except that I do hope, though I am a patentee, that the patent laws of this country will soon be abolished, or amended, being useless as they at present stand.* N.

Gateshead, July 28, 1845.

ABSTRACTS OF SPECIFICATIONS OF RECENT ENGLISH PATENTS.

JOSEPH WEIGER, M.D., OF VIENNA, *for improvements in the amalgamation,*

* Why useless? According to our correspondent's own showing, they are so far useful that such foolish pretensions as those of Mr. Ronald stand no chance against them. His premises and conclusions are strangely at variance. The laws are in themselves, to our thinking, good enough; it is the excessive expense of putting them in force which is the great evil requiring remedy.—ED. M. M.

alloying, and soldering of certain metals. Patent dated, December 12, 1844; Specification enrolled, June 12, 1845.

Dr. Weiger's improvements are stated to have reference principally to the plates, springs, wires, &c., used by dentists. The silver and other metals which he employs are first obtained in the separate state by the following processes:—*Silver* is purified by dissolving it in nitrous acid; then precipitating it with muriatic acid, or with a solution of culinary salt, and afterwards decomposing the product by treating it with vegetable alkali or colophony. A pure *gold* is obtained by digesting gold in nitro-muriatic acid, composed of one part strong nitric acid, and two parts of muriatic acid, and then treating the digestion in a solution of sulphate of iron. *Platinum* is obtained by digesting the metal in nitro-muriatic acid, as in the case of gold; the chloride thus produced is then treated with sal-ammoniac, which affords a triple salt, in the form of a yellow powder, which is converted into pure platinum by subjecting it to a red heat in a suitable furnace. *Palladium* is obtained by treating native platinum according to the usual and well-known methods.

The several metals obtained as above are prepared for the process of compounding as follows:—Gold, silver, and palladium are first to be fused together, and the platinum added gradually to the mass in a comminuted state. Borax is used as a flux, in the proportion of one-fifth of the volume of the metals under operation; and to this the tartrate of potassa is added, in the proportion of one twenty-fifth part of the volume of the metals. In the process of fusion, it is necessary that the fusion of the gold and silver should take place first, and that the platinum or palladium should be then added to the metals already fused. In the case of platinum, the addition is made gradually and slowly. The fluxes are added at or near the commencement of the process. The relative proportions of the several metals used in the foregoing processes may be stated in a tabular form as follows. The number of parts of each is placed under their names respectively:—

No.	Gold.	Silver.	Platinum.	Palladium.
1	1	..	2	..
2	1	1	4	..
[illegible]	..	1	2	1
[illegible]	2	1	9	..
5	2	1	6	..
6	..	1	2	..
7	6	..	10	8
8	4	6	14	..

In *soldering*, the patentee proceeds as follows:—Platinum is soldered with pure gold or silver, or with pure gold and silver in combination, and compositions of platinum are soldered with pure gold. A mixture of two parts silver with one part of gold is stated to be suitable for soldering other metals, and their compounds.

Gamble, Josias Christopher, of St. Helens, *for improvements in the manufacture of sulphuric acid.* Patent dated Dec. 4, 1844; Specification enrolled June 4, 1845.

These improvements consist in the abstraction of the heat produced by the combustion of the metallic sulphurets employed in the manufacture of sulphuric acid, and applying it to the evaporation of acid and saline solutions. The metallic sulphurets employed in this manufacture, are the bisulphurets of iron and copper, and the great heat produced by their combustion injures the leaden chambers, rendering the sulphuric acid less pure and retarding its formation. The apparatus for extracting the heat and applying it to the purpose of evaporation, consists of a furnace in which are four kilns for burning pyrites, with two flues; the one in which the nitric-acid gas is produced, and the other for conducting it to the chimney. The nitre pots are put in at one end of the former of these flues, and taken out at the other; the apertures being all closed with doors when not in use, with the exception of those employed in discharging the pyrites. Above the flue that conducts the nitric-acid gas into the chimney, are three other flues, (also opening into the chimney,) which conduct the sulphurous-acid gas away from the kilns above mentioned. By this arrangement the nitric and sulphurous acid gases are kept separate until they enter the chimney, from whence they proceed to the leaden chamber. The kilns are in the shape of inverted rectangular truncated pyramids, 15 inches in diameter at bottom, 36 inches wide at top and 8 feet deep; they are fitted with doors for charging and stirring the material, and have also an opening for withdrawing or discharging the same. Over the kilns is thrown an arch of 10 feet in length, the spandrils of which are filled up to a level with the crown, so as to form a level bed whereon to rest one of the leaden evaporating pans; there are two other leaden evaporating pans placed over the flues that conduct the sulphurous-acid gas into the chimney; these pans, like the one above mentioned, are each 10 feet long and 6 feet wide, and are supported by iron bars resting on the walls of the furnace. These evaporating pans are in close contiguity and elevated in succession 2 inches above each other. Into the highest, or that which is nearest the leaden chamber formerly mentioned, weak acid is introduced, about

the specific gravity 1·520, and brought forward by degrees to the lowest pan, where it is concentrated to 1·750. When soda is to be concentrated, or the solutions of common salt, a single iron pan may be used instead of the leaden pans above described.

Since the flues conveying the sulphurous-acid gas to the chimney are liable to get stopped by the sublimation of the volatile metallic oxides, it is necessary to have holes at the ends near the chimney for the purpose of cleaning them when foul.

The claim in this case is, to the application of the heat produced by the combustion of bisulphurets of iron and copper, in making sulphuric acid, for concentrating that acid and other saline solutions.

The specification is accompanied by drawings to show the nature of the apparatus employed, and the manner of conducting the process; but it is presumed, that practical chemists will perfectly understand the arrangement from the above description.

CANAL STEAM NAVIGATION.

On the 22nd ult., a trial was made on the Grand Junction Canal, of a small experimental steamer fitted with submerged propellers (not screws) on a plan recently patented by Captain W. H. Taylor. It was witnessed by the chairman and several of the directors of that navigation, and gave, we understand, the most unqualified satisfaction. No perceptible wave was produced by the boat when towing at the rate of four miles an hour, which is as great a speed as is required for the goods traffic on canals. We had ourselves, not long ago, an opportunity of seeing this boat at work on another canal, and were much struck with the absence of every external sign of the motive-power by which it was propelled. Not the slightest swell by which injury can be done to the banks, but an air bubble or two at the sides, which vanished as soon as generated. The success of this invention has led to the formation of an association for carrying goods by steam on the Grand Junction and other canals in connection with it; and so far as all the heavier kinds of goods are concerned, there can be little doubt of the canals being at length enabled, by this means, to compete effectually with their powerful railway rivals. In an early number we shall give a full description of Captain Taylor's invention.

THE "METEOR" AND "FAIRY."

Sir,—In your last Number, I see there is a letter from Mr. Cruden, of Gravesend, professing to give a true account of the tial of speed between the *Fairy* and the *Meteor*, when, in fact, it is nothing of the kind. The true particulars are these. The *Meteor* left Blackwall *before* the *Fairy*, and the latter was obliged to stop at Woolwich to take in stores, and not, as erroneously stated by Mr. Cruden, from "*declining further contest.*" I think no man that knows how to judge the speed of one vessel as compared with another, would say (with such a trial as stated above) that the *Meteor* is the fastest boat by 1½ mile per hour. The *Fairy*, after taking in stores, proceeded to Greenhithe, to have her compasses rectified. In the meantime, the *Meteor* had proceeded on her passage to Gravesend; and having landed her passengers, returned to Greenhithe to have a trial with the *Fairy*; but the latter was unable to accept the challenge, as it was of the greatest importance she should proceed to Portsmouth with as little delay as possible. I merely write this that the public may know what is really the case, and not be misled by that which is not the truth.

I remain, Sir,

Your obedient servant,

VERITAS.

London, July 30, 1845.

NOTES AND NOTICES.

Weston-super-Mare Suspension Bridge.—We perceive from the *Gazette* of this beautiful and thriving watering place, that measures are in full progress for connecting the mainland to the island of Bernbeck, by means of a suspension bridge on Mr. Dredge's principle. It is to be 1100 feet in length; the central span 545 feet; and the outside openings 272 feet.

The "Fairy."—The cause of the *Fairy* having performed so indifferently in some of her recent trips, has been found to be that a rope had got entangled with the screw. The *Rattler* met with an accident of the same sort, when towing the Northern Discovery ships, which made it necessary to take her into Cromarty to be examined, and delayed for a short time the progress of the expedition.

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No.166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

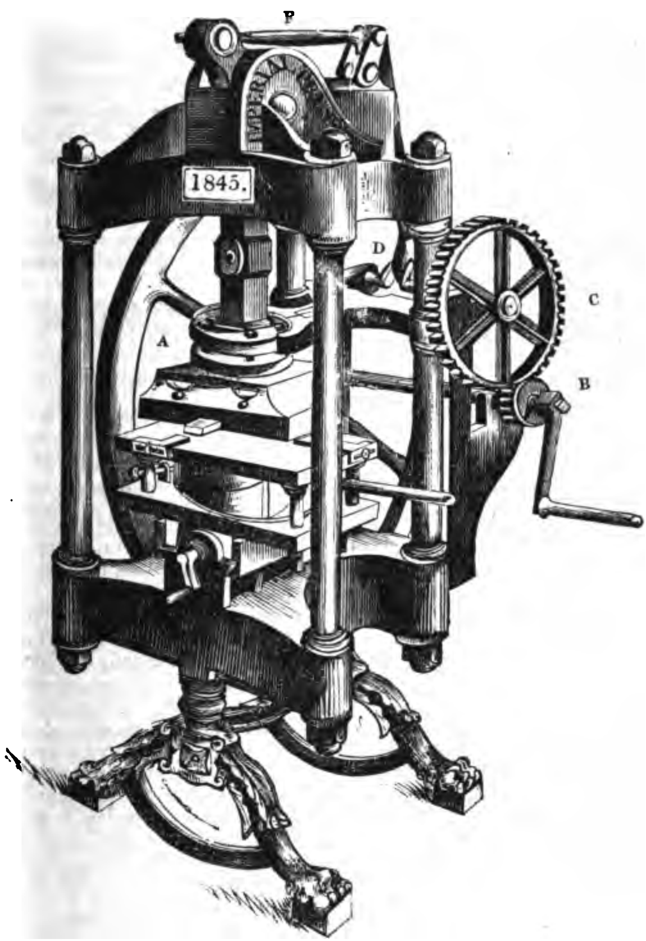
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1148.] SATURDAY, AUGUST 9, 1845. [Price 3*d.*

Edited by J. C. Robertson, No. 166, Fleet-street.

SHERWIN, COPE, AND CO.'S IMPERIAL ROTARY PRESS.

Fig. 1.



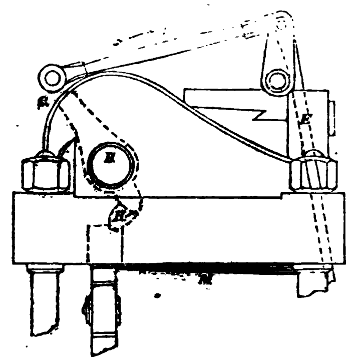
SHERWIN, COPE, AND CO.'S IMPERIAL ROTARY PRESS.

[Registered under the Act for Protection of Articles of Utility. Messrs. Sherwin, Cope, and Co., of Cumberland-street, Curtain-road, Shoreditch, proprietors.]

The present press is an improvement on the press of the same makers, well known to bookbinders and others, by the name of the "Imperial Arming Press." The improvement consists in the substitution of a rotary for a reciprocating movement; and for most purposes there is no doubt that the former is by far the better movement of the two.

A is a fly-wheel (see fig. 1), the rotation of which gives motion to a pinion, B, which moves in its turn the cog-wheel, C. The revolution of these wheels turns a crank, D, which, by means of a connecting-rod E, works an oscillating cross-head, F, from the extreme end of which an arm, G, descends, which turns on a pin, H, and projects a little way down beyond that pin, as shown in the separate view, fig. 2. The under projecting end of this arm G is of the curved form represented in the figure, and acts against a knuckle, H¹, which presses down the head of the piston, so that, as the cross-head F is pulled in the direction of the arrow, the arm G presses down the knuckle and piston; and on the action being reversed, the piston is released, and returns to its original position.

Fig. 2.



M is a strong spring, attached at one end to the back of the frame, and at the other to the piston, to assist in throwing up the piston each time it is released from the pressure of the arm, G.

GEOMETRICAL CONVERSION OF CONVEX SURFACES.

There is a numerous class of propositions in elementary geometry, which are of the greatest utility in practical constructions; yet singular as it may appear, they are, for the most part, either totally neglected by our artizans or but partially brought into use. It would be difficult to assign a reason for this state of things, were we not prepared to attribute it to the circumstance, that, in consequence of the small share of geometrical knowledge possessed by the generality of our operatives, the application of many of those propositions to objects of a practical nature is not very obvious. This is undoubtedly the case, and moreover, as we have frequently had occasion to observe, when a series of principles on a subject that is naturally of a dry and uninviting character are grouped together or brought into one place, without being fully discussed, and at the same time having their practical utility pointed out, that utility, however extensive it may be, is liable to escape detection by the mere practical man, and the principles themselves become, as it were, a dead letter, at least to those for whom the original selection and arrangement were more especially intended; but when a particular problem is separated from the group and considered by itself, without regard to its dependence on other problems of a kindred nature, the application becomes manifest, and the operator, by rendering himself familiar with the process of construction, finds no difficulty, in the course of subsequent enquiries, of singling out the cases to which the particular problem is applicable.

Taking this view of the subject, we propose from time to time in the pages of our Magazine, to consider some of the more important problems of practical geometry, and by treating them severally according to the manner specified, we

hope to invest them with all the generality and importance of which they are susceptible. This being premised, we straightway proceed to consider a few of the cases that more particularly constitute the subject of the present paper.

PROBLEM I. *Having given the diameter of the ends of a right cylinder, and also its axis or length, to determine geometrically the radius of a circle of which the area shall be equal to the convex surface of the cylinder.*

The algebraic solution of this problem is simple enough, but the geometrical solution, which is here required, is not so obvious; for the development of the surface on a plane, according to the usual way, would give a rectangular parallelogram, and not a circle as required by the problem, and the subsequent reduction of this parallelogram to an equivalent circle would only be approximative, whereas the problem is capable of a rigorous determination, since no incommensurable quantities are involved in its construction.

By reasoning on the method by which the convex surface of a right cylinder is calculated, and comparing it with the mode of determining the area of a circle, we shall be led directly to the discovery of the process by which the required object is to be effected, and for this purpose.

Put $d =$ the diameter of the cylinder's base, or the diameter of its circular ends,
$l =$ the length of the cylinder, or the distance between its circular ends or bases,
and $r =$ the radius of the circle whose area is equivalent to the convex surface of the cylinder;

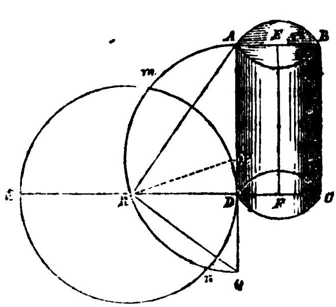
Then, because the convex surface or superficies of a right cylinder, is equal to the rectangle under the altitude and the circumference of its base; we have $3{\cdot}1416\,dl$ for the value of the convex surface; and because the areas of circles are to each other as the squares of their radii, the expression for the area of the equivalent circle, is $3{\cdot}1416\,r^2$, where $3{\cdot}1416$ is the area of a circle whose radius is unity; but by the conditions of the problem, these values are to be equal; therefore by comparison, we get

$3{\cdot}1416\,r^2 = 3{\cdot}1416\,d\,l$; that is, $r^2 = d\,l$;

by casting out the common factor $3{\cdot}1416$, and by converting the remaining terms into an analogy, we get $d : r :: r : l$; where it appears, that the radius of the circle required, is a mean proportional between the length of the cylinder and the diameter of its base, and having discovered this relation, we deduce from it the following construction:—

Let A B C D, fig. 1, be the given cylinder, A B or D C the diameter of its circular ends, and E F its altitude or length; produce A D directly forward till D Q becomes equal to D C, the diameter of the base; then is A Q equal to A D + D C, the altitude or length, and the diameter considered as one line. Bisect A Q in P, and on the point P as a centre, with P A or P Q as a radius, describe the semicircle A *m* R *n* Q, and produce the diameter C D to intersect the semicircle so described in the point R; then is D R a mean proportional between A D and D Q, and consequently,

Fig. 1.



between A D the altitude, and D C the diameter of the base, for by construction D Q is equal to D C.

Draw the straight lines A R and Q R; then, because, by the nature and conditions of the problem, the triangles Q R D and R A D are similar, it follows that Q D : D R :: D R : A D, so that D R is manifestly a mean proportional between A D and D Q; but we have seen above that the radius of the equivalent circle is a mean proportional between A D and D Q, or rather between A D and D C; consequently, D R is the radius of the equivalent circle. Upon R as a centre, with R D as a radius, describe the circle D *m* S *n*; then will the circle so described be equal in area to the con-

vex surface of the cylinder whose length is E F or B D, and diameter A B or D C.

Here we have a very simple and elegant method of converting the convex superficies of a right cylinder into a circle containing an equal area, and it is easy to perceive that such a conversion must frequently be required in the mechanic arts, and more especially by those to whom the method is known; for it is only when the ways and means of effecting a particular object are known, that they are made available for accomplishing other purposes of a similar nature.

If it were required to determine the diameter of the circle, which should be equal in area to the convex surface of an oblique cylinder, the thing could not be done by means of elementary geometry; that is, by straight lines and circles, but would require the delineation of some curve of the higher orders, depending for its description upon the determination of principles, which under certain conditions constitute a problem of very difficult solution.

(*To be continued.*)

IMPROVED MODE OF CASTING METALLIC REVERSES FOR THE ELECTROTYPE.

Sir,—As a material for taking reverses of coins, &c., to receive the electro-deposit, the fusible alloy (3 tin, 5 lead, 8 bismuth) is preferable to those substances requiring a conducting film, on account of the greater certainty of result and simplicity of management attending the use of metallic moulds, and the superior sharpness of the deposited fac-simile.

But hitherto the production of a perfect reverse in metal, according to the methods in use, has been a matter of sufficient difficulty to detract much from the subsequent facility of manipulation.

The simplest methods given by writers on the electrotype, is, to pour the melted alloy on a piece of paper, clear its surface by scraping, and just at its point of cooling to "dash" the medal forcibly upon it. This mode requires too much practice, and is attended by great uncertainty: the scattering of the metal and the consequent thinness of the mould are serious inconveniences, arising from the difficulty of finding the proper moment to strike the impression. In fact, this is nothing but an imperfect *clichée* process, in which the deficiencies are, the want of the pasty condition of the alloy, and the absence of efficient mechanical arrangements.

In any process of casting by impact, success depends on the cooling of the alloy as soon as it is in full contact with the coin to be copied. If the alloy remain fluid after this contact, air is generally retained, and no perfect cast possible. Thus, simply placing the coin on the alloy, or pouring this upon the first, are useless methods, for this reason, independent of the absence of the force necessary to expel the air at first. In consequence of the low fusing point of the alloy, it is commonly poured upon paper, or any non-conducting surface, previous to use, on which it will remain fluid for a long time—a plan which occasions all the difficulties in this kind of casting.

It became apparent to me, that improvement on these methods might be effected by merely expediting the cooling of the alloy. To determine this, taking a small coin in one hand, I poured a portion of the alloy on a cold *iron* slab, and immediately dropped the coin upon it. The alloy became solid on the instant of contact with the coin, and on its removal, exhibited an excellent reverse. To prove the advantage of quick cooling, when a sheet of paper was interposed, the usual difficulties recurred.

In order to adapt this mode to partial purposes, the following simple directions are to be observed. A sufficient quantity of the fusible alloy is to be held in a ladle over a fire until it *just* melts: it is then to be quickly poured upon the metallic slab; and the coin, held ready, instantly allowed to fall flat upon it. The proper height of the fall will vary, of course, with the weight of the coin, and is a matter of easy adjustment: usually two or three inches is sufficient. Sometimes it is convenient to attach another coin, &c., to increase the weight of that to be copied, the objects being the expulsion of air and sufficient depth of impression. The alloy should have a larger surface than the coin, so as to extend around it. If this be not the case, it will be found to spread under the impact, and the marginal parts of the coin will be indistinctly impressed. For the same purpose, when the medallion is large and heavy, a flat piece of wood, having a round hole cut out, may be placed upon

the metallic surface, and the cast made in the hollow thus formed.

The low fusing point of this alloy appears to adapt it for this particular process; for, on substituting type-metal, the results were not satisfactory; nor were those with lead, which congealed too rapidly. A proper relative temperature of the slab might perhaps render other alloys useful; but none of them are likely to be easier in management, or to yield so smooth a surface, as the fusible alloy.

Compared with others, I have found this improved method of taking metallic reverses* much more certain and easy, and so rapid, that with small coins, impressions may be obtained as fast as the alloy can be poured off. The process somewhat resembles that of the *clichée*, is as perfect, but more simple and expeditious. As the reverse is free from roughness or asperities, the voltaic deposit is easily removed.

C. J. JORDAN.†

ATMOSPHERIC PROPULSION—THE PADDLE WHEEL AND OAR—CONDENSATION.

Sir,—I respectfully place at your disposal the following notes of a mechanic, and would be happy should you deem them worthy of a place in your valuable journal.

1. On reading in your Magazine some account of Clegg and Samuda's Plan of Atmospheric Propulsion, as likewise more lately Pilbrow's patent, it occurred that the principal disadvantages of both plans, which are, I believe, the immense expense of construction and limited power, might be obviated by the use of pneumatic pressure. Several mechanical arrangements for this purpose present themselves. I shall describe the most simple, and consider it as adapted to a double line of rails. Stationary engines would require to be placed along the line at intervals of about 10 miles; the first engine being say 5 miles from the terminus. In the space between the double line of rails is carried a strong pipe of about 9 inches diameter, communicating with the pumping engine, and at certain intervals, with cylinders placed horizontally between the rails; these cylinders to be about 10 ft. long, and fitted with piston and piston-rod, having nozzles and valves at each end, wrought by means of levers to be struck by the carriages in passing. The *modus operandi* will then be as follows. The engine having condensed the air in the pipe, a train of carriages, of which the first is fitted with a buffer, on which the end of the piston-rod acts, and likewise having levers to work the valves, being started by rolling some yards down a slope or other means, the carriage lever will open a communication between the back of the piston and the condensed air in the tube; the other end being open to the atmosphere, the piston-rod impinging on the carriage-buffer communicates accelerated motion to the train sufficient to carry it on to the next cylinder, where the process is renewed. These cylinders at the starting-places would require to be at no great distances apart, so as to give momentum to the mass, which being done, and a speed of say 60 miles an hour attained, the distance might be increased to 2000 or 3000 yards.

I have purposely avoided giving any details, save what were actually necessary to describe the application of the principle, as they will suggest themselves at once to all acquainted with mechanics.

There would be on this plan great capacity for high velocities, and one considerable advantage is, that the conductor can regulate the speed by the valves, though at a great distance from the engine. These, and the small expense of working, while not rendering this plan capable of overcoming steep inclines, may yet allow of a comparison with any system yet proposed for moderately level roads.

2. On a slight comparison with the oar in the hands of a skilful rower, the present system of paddle-wheel propulsion appears to great disadvantage. What, for instance, should we think of two Milesians placed on either side of a wherry and urging the boat on by strokes of their shillelahs? The boat certainly would be reacted on by the force exerted, but one skilful waterman would give considerably more speed with less expenditure of power; and that to a certain extent the paddle-wheel is liable to a similar

* I have employed this method since the year 1840.

† Mr. Jordan, as we hope few of our readers have forgotten, is the acknowledged discoverer of electrography, which he first communicated to the world through the *Mechanics' Magazine*, (see vol. xxxi. p. 163.) We are happy to meet with him again as a contributor to its pages.—ED. M. M.

objection may be inferred from the immense waves and churned water produced by them as compared with the absence of even a ripple from the oar in skilful hands.

The contrivances to obviate this have, I believe, *all* failed; yet that it can be done, I know, though I do not intend at present to say by what *means;* but with due caution will say, that a speed of 20 miles over still water can be obtained as economically as 15 at present; and though I have not the means to demonstrate this at present, yet I hope at some future period practically to show the possibility of it.

3. A very good surface condenser for steam-boats I think would be, to have a number of tubes made to revolve at a high velocity similar to Masters' ice-making machine, described in your pages some time ago.

H.

Dundee, 21st April, 1845.

CAN CLOCKS BE RENDERED REGISTERS OF ATMOSPHERIC PRESSURE?

Sir,—I hope that Kinclaven, or some other of your mathematical correspondents, will assist me in the following investigation.

If we suppose a barometer to be attached to the pendulum of a clock, it is plain that the centre of gravity will move in a path different from a circle. Now I wish to find this curve first, and thence to deduce some data by which we might obtain a perfect register of the mean height of the mercury in the barometer by the clock being before or behind mean time.

Such a clock would evidently be an interesting and useful appendage to observatories, as the average height of the mercurial column would be ascertained for a year or a day with equal precision.

J. M.

Trinity College, Cambridge.

CUBIC EQUATIONS.

(Continued from vol. xlii. p. 299.)

We have shown from Tables I. and II., that the value of y in either of the equations $y^3 + y^2 = \frac{r^2}{p^3}$, or $y^2 - y^3 = \frac{r^2}{p^3}$, when they belong to the irreducible case of Cardan's rule, may be found true to six places of decimals; and this, for most purposes, is abundantly accurate; but if a greater number of places should be required, this may be obtained as follows:—Suppose

$$y^3 + y^2 = \frac{8}{343}\ {\cdot}0233236151,$$

then y is found in Table I. to be $\cdot 142+$; hence,

$$y^3 + y^2 = y^2(y+1) = {\cdot}020164 \times 1{\cdot}142 = 023027288,$$

the lesser limiting divisor will be

$$y(3y+2) = {\cdot}142 \times 2{\cdot}426 = 344492,$$

the greater divisor

$$= \tfrac{1}{2}(344492 + {\cdot}143 \times 2{\cdot}429) = 345919,$$

their difference being . $\cdot 1427$

Given equation $y^3 + y^2$. $= {\cdot}0233236151$

Approximate equation ($\cdot 142$) giving $y^3 + y^2$ $= {\cdot}023027288$

Difference . . . . . . $\cdot 0002963271$

$\therefore\ 00029632 + 347 = {\cdot}000857.$

Hence the proportionate divisor is $344492 + 1427 \times 000857 = 34571494$,

$$\text{whence } {\cdot}0002963271 \div 34571494 = {\cdot}0008571428\ \therefore\ y = {\cdot}1428571428,$$

which is true in every figure, the exact value of y being $\frac{1}{7}$, which produces the decimal $\cdot 1428571428$, &c.

George Scott.

16, Wyndham-street, Montague-square, April 28, 1845.

Table III.

For finding the root of the equation $x^3+p\,x=r$, the tabular equation being $y^3-y^2=\frac{r^2}{p^3}$, when $\frac{r^2}{p\,3}$ is greater than $\frac{4}{27}$.

y	$y^3-y^2=$	Limiting divisors.		y	$y^3-y^2=$	Limiting divisors.	
		$z=\cdot01$	$z=\cdot0$			$z=\cdot01$	$z=\cdot0$
1·1	0·121	167	143	6·6	243·936	11937	11748
1·2	·288	219	192	6·7	255·873	12319	12127
1·3	·507	277	247	6·8	268·192	12707	12512
1·4	·784	341	308	6·9	280·899	13101	12903
1·5	1·125	411	375	7·0	294·000	13501	13300
1·6	1·534	487	448	7·1	307·501	13907	13703
1·7	2·023	569	527	7·2	321·408	14319	14112
1·8	2·592	657	612	7·3	335·727	14737	14527
1·9	3·249	751	703	7·4	350·464	15161	14948
2·0	4·000	851	800	7·5	365·625	15591	15375
2·1	4·851	957	903	7·6	381·216	16027	15808
2·2	5·808	1069	1012	7·7	397·243	16469	16347
2·3	6·877	1187	1127	7·8	413·712	16917	16792
2·4	8·064	1311	1248	7·9	430·629	17371	17243
2·5	9·375	1441	1375	8·0	448·000	17831	17700
2·6	10·816	1577	1508	8·1	465·831	18297	18163
2·7	12·393	1719	1647	8·2	484·128	18769	18532
2·8	14·112	1867	1792	8·3	502·897	19247	19007
2·9	15·979	2021	1943	8·4	522·144	19731	19488
3·0	18·000	2181	2100	8·5	541·875	20221	19975
3·1	20·181	2347	2263	8·6	562·096	20717	20468
3·2	22·528	2519	2432	8·7	582·813	21219	20967
3·3	25·047	2697	2607	8·8	604·032	21727	21472
3·4	27·744	2881	2788	8·9	625·759	22241	21983
3·5	30·625	3071	2975	9·0	648·000	22761	22500
3·6	33·696	3267	3168	9·1	670·761	23287	23023
3·7	36·963	3469	3367	9·2	694·048	23819	23552
3·8	40·432	3677	3572	9·3	717·867	24357	24087
3·9	44·109	3891	3783	9·4	742·224	24901	24628
4·0	48·000	4111	4000	9·5	767·125	25451	25175
4·1	52·111	4337	4223	9·6	792·576	26007	25728
4·2	54·448	4569	4452	9·7	818·583	26569	26287
4·3	61·017	4807	4687	9·8	845·152	27137	26852
4·4	65·824	5051	4928	9·9	872·289		27423
4·5	70·875	5301	5175	10	900	310	280
4·6	76·176	5557	5428	11	1210	374	341
4·7	81·733	5819	5687	12	1584	444	408
4·8	87·552	6087	5952	13	2028	520	481
4·9	93·639	6361	6223	14	2548	602	560
5·0	100·000	6641	6500	15	3150	690	645
5·1	106·641	6927	6783	16	3840	784	736
5·2	113·568	7219	7072	17	4624	884	833
5·3	120·787	7517	7367	18	5508	990	936
5·4	128·304	7821	7668	19	6498	1102	1045
5·5	136·125	8131	7975	20	7600	1220	1160
5·6	144·256	8447	8288	21	8820	1344	1281
5·7	152·703	8769	8607	22	9164	1474	1408
5·8	161·472	9097	8932	23	9638	1610	1541
5·9	170·569	9431	9263	24	11248	1752	1680
6·0	180·000	9771	9600	25	14000	1900	1825
6·1	189·771	10117	9943	26	15900	2054	1976
6·2	199·888	10469	10292	27	17954	2214	2133
6·3	210·357	10827	10647	28	20168	2380	2296
6·4	221·184	11191	11008	29	22548	2552	2465
6·5	232·375	11561	11375	30	26100		2640

BEAUMONT'S ANTI-FRICTION VALVE.

[Registered under the Act for the Protection of Articles of Utility. Joseph Beaumont, of Batty-street, Commercial-road, Engineer, Inventor and Proprietor.]

Fig. 2.

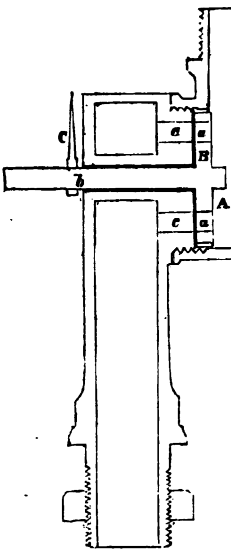


Fig. 3.

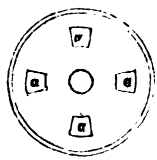


Fig. 1.

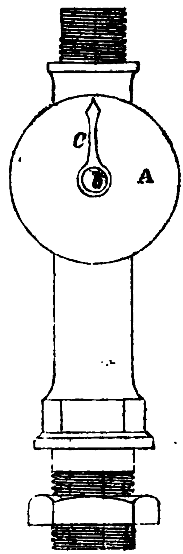


Fig. 1 is an external elevation, and fig. 2 a section of this valve. A is the valve-box; B the valve, and *b* the spindle. The valve consists of a circular plate with four apertures in it, *a a a a*, as separately shown in the plan, fig. 3, which are opened by turning the handle round till the apertures coincide with the water ways in the valve-box, and closed by the reverse action. C is an index, which is attached to the spindle outside of the valve-box, and indicates by its position that of the valve plate. When exactly vertical the valve is open; when turned on either side, the valve is more or less closed.

We believe this valve to be new, and likely for a great many purposes to be eminently useful.

ICE FORMED ON THE FIRE, ACCOUNTED FOR INDEPENDENTLY OF THE SENSATIONS HEAT AND COLD.

[For particulars of the proof experiment, see *Mechanics' Magazine*, of the 5th July, p. 12.]

The oxygen of water is a natural preventive of congelation; cold is no more concerned than the feeling, in which alone it consists, in causing water to be congealed.

In winter, the state of the atmosphere promotes the escape of the oxygen of water; in the laboratory of the chemist, by tapping against the side of the containing vessel, the escape is facilitated.

That congelation depends on the water losing oxygen, is inferable from the experiment of Priestley, in which, at the instant of congelation, "air purer than atmospheric was given out from the water;" which could be no other than highly respirable air, therefore oxygen air.

From this fact, the just inference is, that the water in the crucible suffered congelation in consequence of its oxygen having escaped with the sudden evaporation promoted by the addition to the globule of water of the sulphurous acid; heat, cold, and temperature, or degrees of either, being wholly foreign to matter,

it is only on mechanical principles that this, or any other physical phenomenon, should be illustrated, and that its philosophy can be natural.

Modern philosophy is not that of physical nature, because it materializes every sensation, whereas, what sensations are, matter is not, in any respect. By the functions of our senses we know nothing but sensations; yet, because each *seems* to belong to its external promoting means, we identify the metaphysical—the mental effect—with the remote material object, and then philosophise on bodies as if light, colour, heat, cold, sound, flavour, and odour, were material, and properties, qualities, or states of matter and bodies, although the whole are but sense-excited mental effects, consequently have existence only in the minds of sensitive beings. While the contrary is thus absurdly maintained, all human philosophy must be false; and phenomena the most simple appear as unaccountable anomalies in the general laws of mechanical nature.

T. H. Pasley.

Jersey, July 19, 1845.

NEW YACHT STOVE.

[Registered under the Act for the Protection of Articles of Utility. Messrs. Deane, Dray, and Deane, of the Finsbury Iron Works, Proprietors.]

Fig. 1.

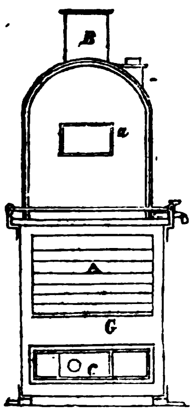
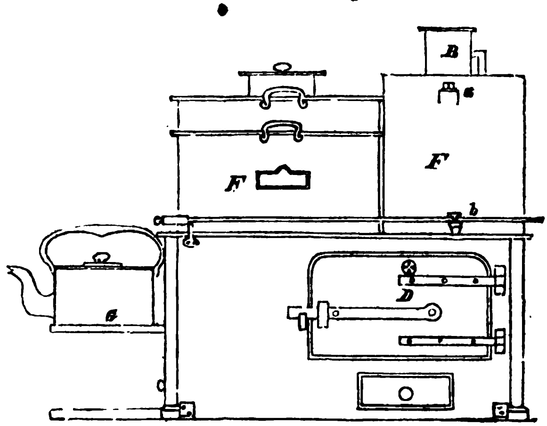


Fig. 2.



In the present yachting season, we believe we shall be doing an acceptable service to many of our nautical readers (not few in number, we are glad to say,) by bringing under their notice the very useful contrivance represented in the above engravings.

Fig. 1 is a front view of the stove, and fig. 2, a side view.

A is the fire-place, the flue, or flues leading from which terminate in a chimney B; C is the ash-pit; D a hot chamber; E, a boiler with supply-pipe *a*, and drawing-off tap *b*; F, a moveable set of boiling pans, and G a projecting support for tea-kettle.

None of the parts of this design are claimed as individually new, but the combination of them, in the compact and convenient manner represented, is registered as forming a stove of a shape and configuration peculiarly suited for yachts and other vessels.

ACTION OF SEA-WATER ON IRON.

[From Report of the Harbours of Refuge Commissioners.]

Letter from Professor Faraday to Sir Byam Martin.

Royal Institution, June 12, 1844.

Sir,—I hasten to reply to your note, though not, I fear, with any very certain knowledge, for infirm health has prevented me from taking up the consideration of the action of sea-water on iron so practically as

I should have liked to have done; but I will give you my opinion and views as far as my observation and judgment will permit. I conclude that the question is of cast-iron in sea-water. Between these two bodies there is a vigorous action; as far as I have been able to observe, it is greatest in the water near the surface, less in deep water, and least of all where the iron is buried in sand, or earth, or building materials, (into which the water may penetrate); for then the oxide and other results formed, are detained more or less, and form, sometimes, a cement to the surrounding matter and always a partial protection. Soft cast-iron, as far as my experience goes, (which is not much,) corrodes more rapidly than hard cast; and the soft, gray, and mottled iron, more rapidly than the brittle white iron. As to the amount of corrosion in any given time, I have not had the opportunity of observing any good and satisfactory cases of illustration.

In estuaries and the mouths of rivers, it is very probable that great differences of corrosion will arise from the different circumstances of variable softness, the soil of the river, if near a town, the matters brought down by the waters, &c., &c. The association of iron also with other substances, if metallic, will much affect it; thus a wharf of cast-iron might occasionally be greatly injured by making fast to it vessels that are coppered, using iron cables.

As to the protection of iron, and first by a coating: the permanency of a coat of paint, or of tar, or bituminous matter, can only be ascertained by reference to experience; of this I have none; except that in a case where coated iron sheathing for ships was brought to me, I was much impressed with the very thorough adhesion of the coat to the iron; the process was patent, and I cannot remember whose it was.* Zinked iron would no doubt resist the action of sea-water as long as the surface was covered by zink, or even when partially denuded of that metal; but zink dissolves rapidly in sea-water, and after it is gone the iron would follow.

As to voltaic protection, it has often struck me that the cast-iron piles proposed for lighthouses or beacons might be protected by zink in the same manner as Davy proposed to protect copper by iron; but there is no doubt the corrosion of the zink would be very rapid. If found not too expensive, the object would be to apply the zink protectors in a place where they could be examined often, and replaced when rendered ineffective; in this manner I have little doubt that iron could be protected in sea-water. It is even probable that, by investigation and trial, different sorts of iron might be easily distinguished and prepared, one of which should protect the other; thus soft cast-iron would probably protect hard cast-iron; and then it would be easy to place the protecting masses where they could be removed when required.

Hence, though iron be a body very subject to the action of sea-water, it does not seem unlikely that it might be used with advantage in marine constructions intended to be permanent, especially if the joint effects of preserving coats and voltaic protectors were applied. Perhaps engineers are in possession of practical and experimental data sufficient to allow of the formation of a safe judgment on this point; for my own part I am not, and therefore am constrained to express the above opinions with much doubt and reserve. I am, Sir,

Your very obedient faithful servant,

W. Faraday.

Sir T. Byam Martin, G.C.B.,
&c. &c. &c.

* Query, Mr. Mallet's?*—Ed. M. M.

ACCOUNT OF THE DESTRUCTION OF THE WOOD PILES OF THE PIER AT BRIGHTON, AND OF THE PROTECTION GIVEN TO THE NEW PILES BY COVERING THEM WITH FLAT-HEADED IRON NAILS. BY CAPT. SIR SAMUEL BROWN, R.N., EXTRACTED FROM A LETTER TO THE CHAIRMAN OF THE HARBOURS OF REFUGE COMMISSIONERS.

My dear Sir,—Agreeably to your request I now beg to send you a brief description of the destructive effects of the insect called by entomologists Teredo navalis, or Sea-worm, on the piles, diagonal shores, and other framing of the Brighton Pier.

I may first observe, that my original intention was to use "cast-iron piles," diagonal shores, in various parts of the structure, instead of timber, which, coming to the knowledge of Sir Humphrey Davy, he wrote to me expressing his opinion, supported by several facts which had come under his own observation, that the salt water would, in the course of time (but without naming any period) decompose the cast-iron under water, and reduce it to a state approaching to plumbago, which would destroy its metallic property, and of course its stability. Receiving information on this important point from such high authority, I wrote to him expressing my obligations for his valuable communication, and abandoned the project of the cast-iron piles. Before I commenced the Brighton Pier, I had completed the Trinity Pier, near Newhaven, in the Firth of Forth; the outer head of this work is about 750 feet from the bulwark of the beach; the piles were driven about 10 feet into stiff blue clay. In the course of three years the ra-

vages of this insect first became visible; but their destructive effects are so rapid, that in six years the piles, from about half tide to the ground, were reduced from 12 to 14 inches diameter to 9 or 10 inches, and before they were entirely removed and replaced, they were reduced to a mere shred. The lower part of these piles had been charred and saturated with boiling coal-tar, in an iron trough made for the purpose. In the course of time all the defective piles were drawn out, and the new timber, which was scarfed to the superstructure, is at this moment in perfect preservation, was filled with scupper nails, which, up to the present time, appears to be an effectual remedy. This pier, which was so essentially necessary, and completely answered the purpose, has, since the construction of the Granton Pier (which is about half a mile to the westward) fallen into decay; and as the intercourse will not pay the expense of keeping it up, it will most likely be removed. About two years after the erection of the Trinity Pier, I projected the Brighton Pier, which, as I have just stated, I intended to construct of iron; most unfortunate for the preservation of this work, I was not apprised of the ravages of the insect before named, and took no precautionary means, except of saturating the lower part of the piles with hot coal-tar.

It is possible, although we have no means of ascertaining the fact, that this coating may be an effectual defence for a time; but, in the exposed situation of the Brighton Pier, where the sea breaks through with such strong force, it is very soon scoured off, and the first attacks of the insect were so imperceptible, that they had established themselves in myriads before we were aware of the extent of the destruction; and I am inclined to think that this insect is engendered from spawn, or ovæ on the pile. When perfectly formed, it bears some resemblance to a diminutive shrimp; they are constantly at work, and their activity so amazing, that in the course of a few years the whole of the piles in the outer head, which were all 14 inches square, were reduced to 8 or 10 in some parts, and the second and third station were also much injured. But there must be either some difference in the habits of the insect or the quality of the timber; for while some piles have been externally reduced, others have insinuated themselves through the most minute perforation, and without causing any material diminution of the dimensions, some piles have been found nearly gutted. In fact, without troubling you with any further minutiæ, I may sum it up in a few words. With the exception of four, which it is not intended to remove, and which are now almost severed, the whole of the lower parts of the piles have been cut off about the high-water line, and others driven in their places and securely scarfed to the upper part. Several remedies were proposed in the progress of repairs, but although I was perfectly willing to give all inventors a fair trial, I could not risk the stability of the pier on their reports, however plausible, and I have taken the only remedy which, as far as appearance can be relied on, is quite effectual, viz., that of filling all the new timber with broad-headed iron nails, resembling scupper nails, but considerably larger; in the course of a few months corrosion takes place, and spreads into the interstices, so that the piles appear to be sheathed with plate iron; probably it may be an improvement worth the attention of the Commissioners to use *square-headed nails*, which leave no interstices.

This subject must be so closely connected with many of the important objects which the Commissioners have in view, that their researches will not be confined to Brighton, or any particular locality. Wherever we go we find "Teredo navalis" (or by whatever name designated) exists to a certain extent, and their destructiveness is not confined to timber in salt water alone; for in 1829, when I was building the Union Bridge over the Tweed, I had occasion for timber for a temporary purpose, and I procured some which had been used in the Harbour at Berwick, where the water is slightly brackish, and I found that worms had perforated a very large portion of it. Travelling south we find that this destructive insect exists to a great extent at Sheerness. I have understood that many piles used as fenders to the wharf wall, and which had been coppered, were, notwithstanding, found to be entirely destroyed inside; but there is a case which, although of a limited and partial nature, is, as far as it goes, much more in point, because nearer the locality of the contemplated operations.

I have no doubt you will recollect writing to me (which letter I received in Paris), requesting me to proceed to Deal, and meet the late Lord Liverpool, Sir Edward Owen, and yourself, for the purpose of ascertaining the most eligible situation for the construction of a pier, intended to be similar to the Brighton Pier in all essential points. I met you accordingly at the Naval Yard; the site was fixed on for the purpose, and I received directions from the Navy Board to prepare plans and estimates for the work, which, having complied with, was accompanied with an offer from yourself to construct the pier. In the interim Mr. Traunsell, the storekeeper, had received information that the worms or insects had proved most destructive to timber; in corroboration of this fact, several pieces of wreck, and two or three anchor stocks, that had been picked up op-

posite the yard, were completely destroyed, in consequence of which the plan was given up. Previously to trying any chemical preparation, I partially coppered a few of the new footed piles, by woolding them round with spiral strips of copper 2 inches wide, but it was soon found that this plan afforded no protection to the intermediate timber, although it certainly preserved it under the copper. This I attribute entirely to the insertion of nails, which suggests the idea that copper sheathing, notwithstanding the failure at Sheerness, may prove an effectual remedy. It must be evident, that as they could not penetrate the copper, or insinuate themselves in the seams, they must have got in at the bottom of the lower sheet, and so worked upwards; now they could have been effectually prevented by driving in two or three rows of copper nails close to the edges of the lower sheet, also the upper sheet if under water, and the copper should in this case reach 3 or 4 feet under the surface, where this insect does not arrive. The chemical application for the prevention of the insect was several years ago (Kyan's Anti-dry-rot) applied to a plank nailed at the low-water mark to a pile; in a few years it was quite perforated. About three years ago Prichard's oil of tar was tried and failed. Payne's process, utter failure. The asphalte, Matthews (the Pier Master) thinks, if it would adhere to the pile it would resist them, but with the utmost care in driving it breaks off. From all these facts, I must come to the conclusion that at present there is really no specific remedy against the attacks of the insect except the iron nails; it is quite clear that it never can, like cast-iron, be reduced to the state of plumbago, and that its total destruction from the effects of corrosion must be very remote. Although you have not adverted to the breakwater, I have no doubt that you have that object almost paramount to all others under consideration. I have a good opinion of Captain Tayler's floating breakwater, and have no doubt of its affording perfect shelter in many situations, and I think it quite practicable to moor it securely, so that it would ride out the heaviest gale or sea; but I dread the effects of the worms, for he is too confident in the efficacy of some newly discovered solution which he calls marine poison. If his plan goes on to any extent, which I see no appearance of in this country, he must resort to the iron nails, which will increase his estimate prodigiously. But I hope soon to have the honour of submitting models, which I have nearly completed, of floating and fixed breakwaters which are intended to be constructed of a framing entirely of bronze, which it is known is imperishable in all situations; the spaces between the sloping and horizontal ribs may be filled with any common, cheap material, such as turf, peat, or fascines, not packed together, but close enough to subdue the heaviest waves in passing through it, without opposing a solid front of resistance. Requesting your pardon for being carried so far beyond the subject of your enquiries, I remain, my dear Sir,

Your most faithful Servant,

(Signed) SAMUEL BROWN.

4, Park Villas, Blackheath, June, 6, 1844.

To Admiral Sir Byam Martin.

APPLICATION OF SPRINGS TO MUSICAL STRINGED INSTRUMENTS.

Report of the Committee of the Franklin Institute on the Pianoforte of Lovering Ricketts.

The Committee have examined with care the piano exhibited to them by Mr. Lovering Ricketts, and find the alleged improvement to consist of springs to which the strings are directly attached. In the language of his patent, his claim consists in the "application of my metallic springs to the piano, harp, and all other musical stringed instruments, as an improved substitute to the common hitch-pins now used, and for the purpose of giving elasticity to the strings, and for keeping them in tune for a long period of time."

In the piano examined by the committee, blocks of metal are inserted into the plate of the instrument, to which horizontal springs are attached, and the strings are hooked upon the ends of these springs, so that when the strings are tightened by the turning of the pins when the instrument is tuned, the strain bends the springs until the resistance is such as to maintain the string at the degree of tension necessary to sound the desired, or proper, note.

On examination it was found that the springs operated according to the views of the patentee; as the strings were strained by the tuning pins they slipped by the pins of the bridge, and drew the springs until the tension was equalled by the resistance necessary to produce the required note, and that upon turning the tuning pins backward, the springs drew the strings back, and the note fell as the tension diminished; thus showing that the operation of the springs was, so far, satisfactory.

It is probable that the views of the patentee are correct in the supposition, that the construction of a piano on this principle will enable it to remain in tune a longer time; or, more exactly to express the views of the committee, it will go out of tune more gradually than those of the usual construction; but this assertion is entirely comparative; how much slower, would require a careful comparison with other in-

struments of the same general construction, and a similar grade of workmanship and material. That it will go out of tune from all the usual causes is beyond a doubt, as those causes will affect the instrument under consideration in the same manner, and to the same extent as any other, such as constant tension upon the string itself, the expansion or contraction, from changes of temperature, and the general yielding of the wood work forming the body of the instrument.

There is reason to doubt the purity of tone to be derived from a string, the strain of which is supported in the manner described by the patentee.

A light blow of the hammer, it is probable, would not affect the spring, and a perfect vibration would be produced; but if a heavy blow should be given, and "repeated," as is usual in the modern style of playing, is it not evident that the spring would yield, and as a consequence, the length of the string be augmented between the bridges, producing, for the time being, a note, or chord, out of tune. And again, suppose, what is so usual in music, a light passage in the treble, not affecting the springs, in that part of the instrument, and a heavy, or loud, chord on the bass acting powerfully upon the springs, the bare supposition is a dissonance too great to be borne with composure, and that such is the fact the committee have abundant evidence.

This inseparable disadvantage must be increased by perfection of workmanship, and the improved action of the spring consequent therefrom. Mr. Ricketts' instrument appears to have been got up in haste, and is not, therefore, amenable to this remark in its greatest extent.

In the claviole of the ingenious John I. Hawkins, an instrument of extraordinary power and beauty, a combination was attempted by which the effect, expression, and compass of the violin, tenor, bass, and double bass, in short, the stringed quartette, was to be brought under the hand by means of the ordinary finger-board of pianos and organs. In this instrument a difficulty occurred which taxed, to their fullest extent, all the inventive powers of this extraordinary man—and that was, the maintenance of the proper degree of tension of the strings made of animal tissue, a well-known difficulty in all instruments of music in which these kinds of strings are employed — hygrometric changes, as well as those of temperature, affecting them rapidly, and to a great extent.

This difficulty Mr. Hawkins attempted to meet by the introduction of springs, to which the strings were attached, so as to maintain a tension proportionate to the changes, hygrometric and otherwise, which always affect these means of producing musical tones. His singular sagacity must have been severely tasked, as we have evidence that he introduced progressive lever arrangements in conjunction with springs, on the general principle of the fuzee of the watch, in the endeavour to meet the contingencies of the case. These and other difficulties have doubtless hitherto prevented the adoption of an instrument, which, if it could be perfected, would be of incalculable value to the musical world. The same mechanical genius made pianos with spiral metallic springs, which sustained the tension of the strings, one of which was used in this city, with all the disadvantages which have been noticed in the foregoing paragraphs.

The general inference which is to be drawn from this report is decidedly unfavourable to the alleged improvement; as regards its novelty, we have to add, that besides its general principle, as employed in the claviole and pianoforte of Hawkins, we have evidence that pianos were made in Liverpool, to the strings of which ordinary springs were attached, one of which was sold in this city.

These facts and circumstances relate to a period of time about one-third of a century antecedent to the date of this report.

By order of the Committee,

WM. HAMILTON, Actuary.

Philadelphia, December 12, 1844.

STORER'S DELINEATOR.

Sir,—In the *Mechanics' Magazine* for 19th July last, your correspondent "Homo" requests a description of Storer's Delineator. It was the subject of a patent granted as far back as the 4th March, 1788, in which the inventor is described as of "Lisle-street, Leicester-fields, Middlesex;" and subjoined is a literal copy of the Specification (matters of form omitted) as given in *The Repertory of Arts*, vol. iv. (1796).

I am, Sir, yours obediently,

J. H. W.

Specification.

"To all, &c., &c.—I, the said W. S., do hereby describe my said invention in manner following; that is to say, the accurate delineator may be made in various forms, and the effects above mentioned arise from a new invented application of lenses, mirrors, speculums, prisms, or mediums of lenses of glass, or any composition containing reflecting or refracting powers. The rays from the object are first received on, or conveyed to, a mirror or speculum, placed at a proper angle in the inside of a tube or box, by one or more convex lens or medium of lenses before the mirror or speculum. In cases where the object is conveyed through a lens, or medium of lenses, on the mirror

or speculum, one or more convex lenses or medium of lenses must be applied to correct and illuminate the rays, and to receive from the mirror or speculum the rays from the objects conveyed thereon through the first-mentioned lens or medium of lenses; but in cases where the rays from the object are received in the first place on the mirror or speculum, a convex lens or medium of lenses must be placed, fixed or moveable, next after the mirror or speculum, to collect the rays from the mirror or speculum; and at a proper distance from the first lens or medium of lenses must be applied one or more convex lens or medium of lenses to correct and illuminate the rays from the first lens; by which means all rays that are spherically refracted through the first medium will be made parallel, and consequently all objects are accurately represented, and all parts thereof accurately represented, and all parts equally illuminated on the lens or medium of lenses, so receiving and correcting the rays of the objects received from the mirror or speculum, or first lens or medium of lenses, which gives the most lively and exact representations of the objects, either by the light of the sun, moon, or any other light. In all cases the size of the aperture medium through which the rays first pass must govern the size and powers of the correcting lens or medium, both contrary to the principle of the camera-obscura. A prism, mirror, or speculum being placed at a proper angle to reflect the image on the first lens or medium of lenses, mirror, or speculum, the objects will be represented in their true shape, figure, and form, and a collecting or correcting lens or lenses, or medium of lenses, to collect or correct the rays from the images represented by a reflecting microscope, magic lantern, camera-obscura, or other instrument of like nature, instantly forms the accurate delineator. The principles of the accurate delineator being not so much in the form and figure of the instrument as to correct and collect and illuminate the faint and imperfect rays of the object received through these instruments.

"In witness whereof," &c., &c.

MODE OF COLOURING DAGUERREOTYPE PICTURES. BY C. G. PAGE, PROF. CHEM. COLUMBIA COLLEGE, U.S.

In the month of December, 1842, I instituted a course of experiments to determine the effects of oxidation upon the surface of Daguerreotype pictures; and arrived at some beautiful results in fixing, strengthening, and colouring these impressions. Numerous and arduous duties of a public nature have prevented me from investigating the subject as I wished; and I therefore present the facts, for others to adopt, as the basis of what promises to be a most interesting course of study and experiment. First, a mode of fixing and strengthening pictures by oxidation:—The impression being obtained upon a highly polished plate, and made to receive, by galvanic agency, a very slight deposit of copper from the cupreous cyanide of potassia, (the deposit of copper being just enough to change the colour of the plate in the slightest degree,) is washed very carefully with distilled water, and then heated, over a spirit-lamp, until the light part assumes a pearly transparent appearance. The whitening and cleaning up of the picture, by this process, is far more beautiful than by the ordinary method of fixation by a deposit of gold. A small portrait fixed in this way, more than a year since, remains unchanged. As copper assumes various colours, according to the depth of oxidation upon its surface, it follows that if a thicker coating than the first-mentioned can be put upon the plate without impairing the impression, various colours may be obtained during the fixation. It is impossible for me to give any definite rules concerning this last process; but I will state, in a general way, that my best results were obtained by giving the plate such a coating of copper as to change the tone of the picture,—that is, give it a coppery colour, and then heating it over a spirit lamp until it assumes the colour desired. I have now an exposed picture treated in this way at the same time with the two above mentioned; and it remains unchanged. It is of a beautiful green colour, and the impression has not suffered in the least by the oxidation. For pure landscapes, it has a pleasing effect; and by adopting some of the recent inventions for stopping out the deposit of copper, the green colour may be had wherever desired. In some pictures a curious variety of colours is obtained, owing to the varying thickness of the deposit of copper, which is governed by the thickness of the deposit of mercury forming the picture. In one instance, a clear and beautiful ruby colour was produced, limited in a well-defined manner to the drapery, while all other parts were green. To succeed well in the first process, viz., that for fixation and the production of the pearly appearance, the impression should be carried as far as possible without solarization, the solution of the hyposulphate of soda should be pure and free from the traces of sulphur, the plate should be carefully washed with distilled water, both before and after it receives the deposit of copper,—in fact, the whole experiment should be neatly performed, to prevent what the French significantly call *taches* upon the plate, when the copper comes to be oxidized.—*Silliman's Journal.*

H.M.S. "FAIRY."

Sir,—I beg to hand you an account of the experiments at the measured mile in Long Reach, with H.M.S. *Fairy*, under the superintendence of Mr. Lloyd.

The reports a few days since of the vessel not keeping way with others, known to be inferior in speed, is easily accounted for. On laying her ashore the other day, ropes, to about 18 inches diameter, were found coiled round the propeller shaft, and the blades of the propeller bent to such an extent, that it has been found necessary to substitute a new one. Now, I believe, she is satisfactory even to Her Majesty.

With regard to Mr. Cruden's letter, in your Number of the 26th ult., I can only show you, by letters inclosed, that other people were of the same opinion as myself, that is, that the *Fairy* was as fast as the *Meteor* on the occasion alluded to.

When a screw-boat is put in competition with a Gravesend paddle-wheel boat, it should be recollected that the latter has had twenty years' experience, and perhaps five hundred brains, to bring it to perfection, whilst the former is hardly the twentieth production of its kind.

I remain, Sir, yours respectfully,

JOHN MATTHEW.

1, Egerton-road, Greenwich, August 6, 1845.

[The letters which Mr. Matthew has been so good as to send for our inspection are from parties whose testimony is entitled to great weight, and they certainly do show that he is not singular in his opinion that the *Fairy* showed herself fully equal to the *Meteor* on the occasion referred to. The truth is, that they are both first-rate vessels of the classes to which they respectively belong.—ED. M. M.]

Trials at the Mile in Long Reach with H. M. Propeller Yacht "Fairy."

March 31, 1845.

5·17=11·356		
4·13=14·229	25·585	
4·50=12·414	26·643	52·228
4·25=13·585	25·999	52·642
4·44=12·676	26·261	52·260
4·37=12·996	25·672	51·933
4·21=13·793	26·789	52·461
		5)261·524
		4)52·305
		13·076 knots.
		1·152
		15·063 miles.

April 1.

4·5	14·694		
5·17	11·356	26·050	
4·7	14·575	25·931	51·981
5.7	11·726	26·301	52·232
4·15	14·118	25·844	52·145
5·1	11·960	26·078	51·922
4·24	13·636	25·596	51·674
4·51	12·371	26·007	51·603
4·36	13·043	25·414	51·421
4·27	13·483	26·526	51·940
			8)414·918
			4)51·865
			12·966 knots.
			1·152
			14·936 miles.

April 3.

3·52	15·517		
5·37	10·682	26·199	
3·54	15·384	26·066	52·265
5·32	10·843	26·227	52·293
4·2	14·876	25·719	51·946
5·21	11·215	26·091	51·810
3·58	15·126	26·341	52·432
5·22	11·180	26·306	52·647
4·3	14·815	25·995	52·301
5·18	11·321	26·136	52·131
			8)417·825
			4)52·228
			13·057 knots.
			1·152
			15·041 miles.

April 5.

5·41	10·557		
3·49	15·721	26·278	
5·34	10·778	26·499	52·777
3·45	16·	26·778	53·277
5·32	10·843	26·843	53·621
3·47	15·859	26·702	53·545
5·36	10·714	26·573	53·275
			5)266·495
			4)53·299
			13·325 knots.
			1·152
			15·350 miles.

NOTES AND NOTICES.

The other "Janus."—On Saturday an experimental trip took place in a beautiful new boat, to be named the *Bee*, for the purpose of ascertaining her power of speed. This beautiful vessel is a perfect novelty, being built sharp at both ends, with rudders to ship and unship as occasion may require, and judging from the velocity with which she cut through the water on this trip must have realized the most sanguine hopes of her enterprising projectors, and, no doubt, will prove a great favourite with the public. This vessel is the first of her kind on the Thames, was constructed by Messrs. Ditchburn and Mare, and fitted with vibrating engines by Messrs. W. Joyce and Co., of the Greenwich Iron Works, who have in hand another of the same description, to be called the *Ant*, which will be out in a few days.—*Times.*

The Wonder atmospheric steam-packet, on the Southampton station, since her return from the experimental squadron down the Channel (where she eclipsed every other vessel in speed) has become a great favourite with the public both on the Havre and Channel Islands station, and has carried, notwithstanding the unfavourable state of the weather during the past week, in one voyage on the Havre station, 132 passengers; and one on the Channel Islands station, 191; making a total of 323 passengers, among whom were several families of distinction. The average passage of the *Wonder* has been seven hours and a half, being only six hours of sea voyage.—*Times.*

Lighthouse on the Goodwin Sands.—On Saturday evening last, some of the elder brethren of the Trinity Board put down an iron tube of two feet six inches in diameter into that part of the Goodwin Sands which is most dangerous, as a preliminary to the erection of a light-house thereon. It is on the Callipers, and at a short distance from a bank, which forms a steep declivity to the depth of ten fathoms. The tube descended twenty-two feet into the sand in an astonishingly short time, by the application of Dr. Pott's process, in which atmospheric pressure is the principal agent.—*Weekly Dispatch.*—For a full account of Dr. Pott's admirable process, see Mechanic's Mag. No. 1090.

Steam Boat Building in America.—The St. Louis Reporter gives the following as the dimensions of a steam-boat now lying on the wharves of that city:—Main deck, 450 feet; cabin, 275 ft.; breadth of cabin deck, 70 ft.; length of beam, 38 feet; depth of hold, 9 feet.

The Electric Gun.—Since our last notice of this remarkable invention it has been exhibited to the Ordnance committee at Woolwich. The distance of the target was 40 yards from the gun: at that distance the effect was tremendous; a three-inch plank was perforated, and the balls which struck the iron target flattened as thin as half-crowns—indeed, to mere plates of metal—and frequently beat to atoms. The rapidity of the discharges was very surprising; and they were kept up without intermission apparently as long and as continuously as the engineer thought fit. The cost of keeping the machine in a continual discharge for 18 hours, resting a few minutes every four hours, is estimated at £10; during which time more bullets would be discharged than from the fire of two regiments of musketry, firing at their greatest rate of quickness.

A Tree within a Tree.—Mr. James Davie, joiner, Wooler, has in his possession a curious elm-tree, which he purchased from M. Culley, Esq., Fowberry. After the tree was felled, he observed a circular opening round its centre; and, when he had cut a foot and a half off the thick end, the middle piece, or inner tree, slid out! There was, in fact, a tree within a tree. The diameter of the outer trunk is 15 inches, and of the inner one about 5½ inches. The wood of both trees is perfectly solid. The inner one, however, has no rind, save a thin dark film. The whole length of the tree is about 20 feet. The editor of the *Gateshead Observer* states, that there is a similar tree in the Kirkleatham Museum.

Safety-Lamps—Dr. Reid Clanny.—A perusal of the following extracts from an authenticated document, under the immediate superintendence of Baron Beust, Chief-Director of all the mines belonging to the King of Saxony, will, we trust, be found to be interesting to our readers. The Committee for the inquiry consisted of two Professors of the Mining Academy and the Chief Engineer. "Dr. Reid Clanny's claim (say they) of being the first who invented a safety-lamp in England, is acknowledged as indisputable. * * Dr. Clanny's safety-lamp affords more security than that of Sir H. Davy, and is superior to the safety-lamps in use—particularly in horizontal currents of air. * * Dr. Clanny's lamp appears to be good, durable, and sufficiently protected against ordinary accidents." The document was transmitted to one of our correspondents by Baron Ende, and is dated "Altjessnitz, Prussian Saxony, 15th July, 1845."—*Gateshead Observer.*

Shrinking of the Paper in Impressions of Engravings.—In the course of the evidence on the London and York Railway Bill, a very remarkable instance came to light of the effect of the shrinking of paper in impressions from copper plates. By the deposited plans of this Railway, the elevation at a particular spot, called Greenwood-place-road, appeared to be only 413 feet, while it was found by actual levelling to be 422. Mr. James Wyld, by whom the plans were engraved, being called to explain this discrepancy, gave the following evidence:—"The copper-plate produced was engraved by him, and [illegible] the section (the one on which Greenwood-[illegible] road occurs) was printed from that plate. [illegible] height of Greenwood-place-road measured on the copper is 422 feet, and on the printed copies of the section there is a contraction of about 9 [illegible] reference to the scale, so that the height, as [illegible] by the copies, measures only about 413 feet. [illegible] often known as large an amount of contraction [illegible] explained the mode in which contraction took [illegible] by showing how the sheets of paper, in the [illegible] state, after being printed on, were hung up [illegible] across a line. In consequence of this, the [illegible]tion of the paper prevented the horizontal [illegible]tion from being so great as the vertical. The [illegible]traction of paper varied very much, and was [illegible] equal to 1 in 40, and even 1 in 36. Witness [illegible]sured the contraction of the scales and of some of the figured heights on a sheet of the section printed by him, and found it equal to about 3 feet in 200 in the longitudinal direction, and 5 feet in 200 in the vertical direction."

Baird's Sweeping Paddle.—The Canada journals speak of some invention by this name as a substitute for the paddle-wheel; and they state, that it has been applied to a Government steam-boat, *Experiment*, now stationed at Pentanguishine, Lake Huron, with an advantage in speed of more than 20 per cent.

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1149.] SATURDAY, AUGUST 16, 1845. [Price 3*d*.

Edited by J. C. Robertson, No. 166, Fleet-street.

TRUMAN'S PATENT FILTER.

Fig. 1.

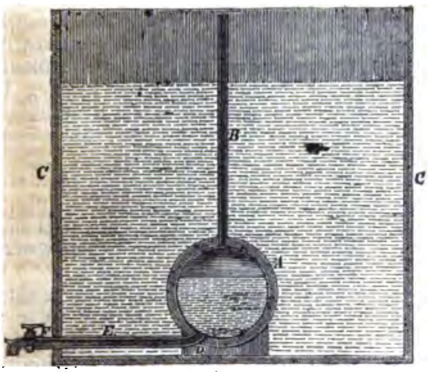


Fig. 3.

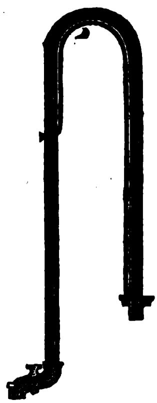


Fig 2.

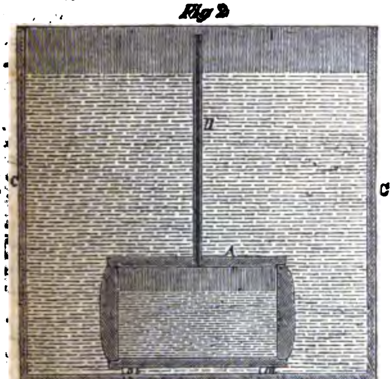


Fig 4.

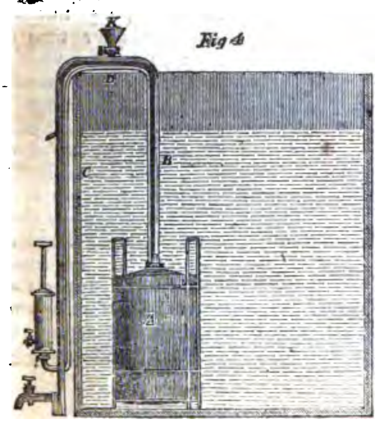
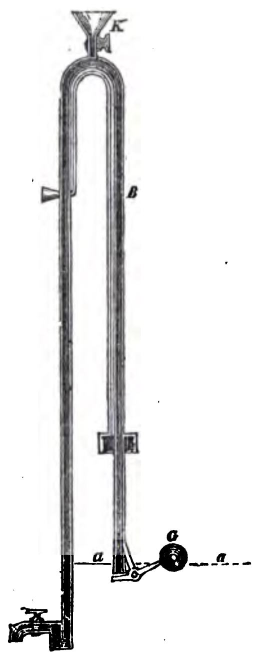


Fig 5.



TRUMAN'S PATENT FILTER.

[Patent dated, February 10, 1845; Specification enrolled, August 10, 1845.]

FILTERS are already so numerous, and of such variety, that one would have thought it next to impossible to invent anything of the kind having the least pretensions to novelty. Here, however, is one which is not only new, but of a highly philosophical and efficient character. In this filter, the pressure of water, the pressure of the atmosphere, and the force of capillary attraction, are all combined to produce the desired effect in a way which we do not remember to have seen before. First, a close hollow vessel of a porous quality, is set in the midst of a cistern of water, and the water left to find its way through it by its own pressure—which it does slowly, but very surely—leaving on the outside of the vessel every impurity which may have been mechanically intermixed with it. As the water flows into this vessel, the air which it displaces is expelled through a vent pipe carried to the top of the cistern. Then, to draw off the filtered water, three several methods are employed; in the first, which depends on the pressure of the atmosphere alone, and is applicable only where the immersed filter is meant to be a permanent fixture, a pipe is carried from the filter through the side of the cistern, and opened and shut by an ordinary tap; in the second, which admits of the filter being moveable, a syphon acting by capillary attraction is made use of; and in the third, which is also suitable for moveable filters, a syphon is employed of the ordinary sort, only that it is provided with means for stopping the flow of the liquid when required.

(1.) Figs. 1 and 2 represent the first of these arrangements. A is the close vessel, which is of a cylindrical shape, and which is made of some natural stone of a porous quality, such as the ordinary dripstone. B is the vent air pipe, which rises from the vessel A. C C is the tank or cistern containing the water to be purified; D, a standard, on which the close vessel A is mounted; E, the discharge pipe, which is carried from the close vessel A, through the side of the tank or cistern, and is opened or shut by the tap F.

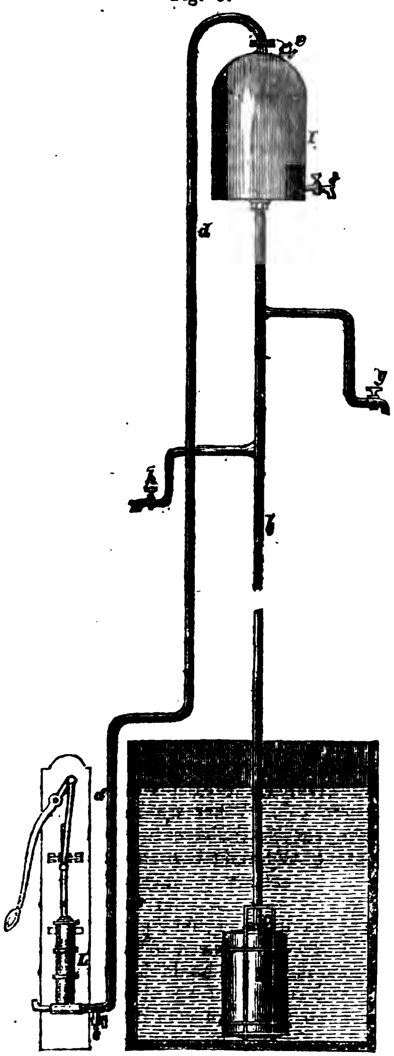
(2.) The capillary syphon is represented in fig. 3. The body of it consists of a number of small metallic tubes of about three-eighths of an inch in diameter, bound closely together. The short end of it is inserted through an orifice in the top of the filtering vessel A, which orifice is then made air-tight by soldering, or by any other suitable means. The air pipe D is curved like the syphon, and inserted into the filtering vessel through the same orifice. For the small metallic tubes a number of threads of cotton, or other fibrous substance, capable of acting by capillary attraction, may be substituted, taking care to enclose in a metallic tube, or other water-tight case, the portion of them which is exposed to the water in the tank outside of the filter A.

(3.) The third arrangement is shown in figs. 4 and 5. G is a ball valve, attached to the short end of the syphon, which, on the water in the filtering vessel A falling below the line *a a*, closes the mouth at that end; and H, a cup affixed to the long end, with a tap to it, by the turning of which tap the filtered water is either drawn, or shut off. K is a funnel placed at the highest portion of the bend of the syphon, by means of which it may be charged previous to water being drawn off by the tap. Or the same thing may be accomplished, by opening the filtered water tap, and applying a blast from the mouth to the air-pipe D D, which is provided with a mouth-piece for that purpose.

When it is desired that the filtration should be conducted very rapidly, an air-pump is attached to the vent air pipe D, as shown in fig. 5, by means of which the air is time after time exhausted, or nearly so, from the vessel A, and the percolation of the water through it thereby proportionally accelerated.

A very clever arrangement for carrying water on the same system to considerable heights—as, for example, from the basement story of a house to the upper stories, or any of them—is shown in fig. 6. A is the filtering vessel and water reservoir as before. I is another close vessel placed in the upper story, which communicates at bottom by a vertical pipe *b*, having a self-acting valve at *c*, with the vessel A, and at top by a

Fig. 6.



pipe d, with an air-pump L. By working the pump the air becomes exhausted from both the vessels A and I, and the filtered water ascends into I. The cock e, being then opened to readmit the air to the top of I, the filtered water in that vessel may be drawn off from it by any of the cocks, f, g, or h; or by making use of a two-way tap, such as is represented in figs. 7 and 8, the water may be drawn off from I without opening the air-tap e; this two-way tap being so constructed as to admit the ingress of the air through the upper orifice i simultaneously with the outflow of the water through k. The upper vessel I, must of course be made sufficiently strong to withstand the external pressure to which it is intended to be subjected.

Mr. Truman states, that though he has "directed that the filtering vessel A should be made of some natural porous stone, because he considers this substance to be under most circumstances the best suited for the purpose, he does not restrict himself to the use of that material, for there are various artificial substances or mediums which may be substituted for it, and in some cases with advantage, as where the natural porous stone can only be had from a great distance and at a heavy expense. The filter might, for example, be made of unglazed stoneware, or of a number of layers of cloth kept distended by strong hoops, or of two concentric metal vessels perforated all over with very minute holes, and having a space between them filled up with fine gravel and sand."

Fig. 7.

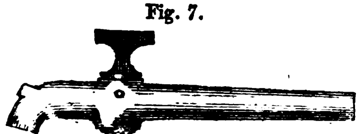
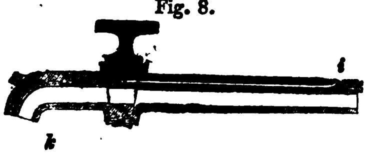


Fig. 8.



GEOMETRICAL CONVERSION OF CONVEX SURFACES.

(Continued from page 84.)

PROBLEM II. *Having given the diameter of the base, and the altitude of a right cone, to find geometrically the diameter of a circle, whose area shall be equal to the convex surface of the cone.*

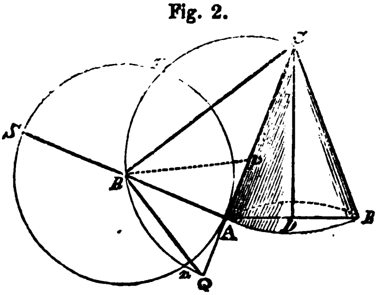
From the peculiar relation that subsists between the cone and cylinder, we may at once infer that a process somewhat similar to that followed in respect to the latter, will be required for the solution of the present problem; we shall therefore adopt a similar means to discover what the nature of the process is; and for this purpose,

Put d = the diameter of the base of the given cone;
h = the altitude or height, sometimes denominated the axis;
s = the slant height or length of the side;
and r = to the radius of the circle whose area is equal to the convex superficies;

Then, since the convex superficies is expressed by the rectangle under half the circumference of the base and the slant height or length of the side, the expression for the convex superficies is $3{\cdot}1416 \times \frac{1}{2} ds$; and as in the case of the cylinder, this expression and that for the area of the equivalent circle, are equal between themselves, by comparison we get $3{\cdot}1416\, r^2 = 3{\cdot}1416 \times \frac{1}{2} ds$, and casting out the common factor, 3·1416, it is $r^2 = \frac{1}{2} ds$; therefore, by converting the terms of this equation into an analogy, we obtain $\frac{1}{2} d : r :: r : s$; from which we infer, that the radius of the required circle is a mean proportional between the radius of the cone's base and its slant height; hence the following construction:

Let A C D, fig. 2, be a right cone, the diameter of whose base is A B, vertical height or axis C D, and slant height or length of the side A C. Produce C A to Q, and make A Q equal to A D, the radius or semi-diameter of the base; then is C Q considered as one line equal to C A + A D, the sum of the slant height and the radius of the base. Bisect C Q

Fig. 2.



in P, and on the point P as a centre, and with P C or P Q as a radius, describe the semicircle C m R n Q; then at the point A in C Q erect the perpendicular A S, intersecting the semicircle just named in the point R, and A R will be a mean proportional between the slant height C A and the semi-diameter A D; for by construction A Q is equal to A D.

Draw the straight lines C R and Q R from C and Q; the extremities of the diameter C Q; then by the nature and conditions of the problem, the triangles Q R A and R C A are similar; hence it follows, that A Q : A R :: A R : A C, so that A R is obviously a mean proportional between C A and A Q. But we have shown before that the radius of the equivalent circle is a mean proportional between the slant height A C and the semidiameter A D, and consequently, A R is the radius of the equivalent circle. Upon R as a centre, with the distance R A as a radius, describe the circle A m S n; then will the circle so described be equal in area to the convex superficies of the right cone A C B.

Since the diameter of the base A B and the vertical height or axis C D, are the data proposed in the problem, it will be necessary in case of a calculation being required, to determine the slant height or length of the side A C in terms of A D and C D; now C D A is a right-angled triangle, from which we get

$AC = \sqrt{AD^2 + CD^2}$; and by restoring the proper symbols, it becomes $s = \frac{1}{2}\sqrt{d^2 + 4h^2}$; in which case we have

$\frac{1}{2} d : r :: r : \frac{1}{2}\sqrt{d^2 + 4h^2}$; or $r^2 = \frac{1}{d}\sqrt{d^2 + 4h^2}$,

an expression of the same value as that which we have previously obtained, but something more complicated in its form, as it involves the calculation of the slant height A C. What we have here said refers only to the case in which a calculation is required; but when the solution is to be strictly geometrical, the slant height is at once determined from the axis and diameter being given.

If it were required to find a circle, of which the area should be equal to the convex surface of an oblique cone, the problem is one of very great difficulty, and could not be resolved by straight lines and circles, nor even by the application of lines of the second order.

(*To be continued.*)

ACCOUNT OF THE VARIOUS IMPROVEMENTS MADE IN THE STOCKING FRAME FROM ITS INVENTION TO THE PRESENT DAY, AND ITS CONNEXION WITH THE LACE MANUFACTURE.

[From Report of the Commissioners appointed to enquire into the condition of the Framework Knitters, 1845.]

In a memorial addressed to the Lords of the Treasury in 1834 against the exportation

of machinery, from the merchants, manufacturers, and others at Nottingham, engaged in the manufacture of silk and cotton bobbin-net lace, the introduction and importance of this manufacture is thus spoken of:—

"The fabrication of thread and silk lace is a very ancient and extensive manufacture, the manner of making which by the hand is a very complicated, tedious, and slow process, and, of consequence, such lace is very expensive and costly.

"That the manufacturers of such lace, particularly of the most costly fabrics, principally resided in the northern provinces of France, in Brabant, Flanders, and the Low Countries, where the female population were to a great extent employed in making lace.

"That although the making of the inferior kinds of lace was extensively carried on in the counties of Buckingham, Bedford, and Northampton, and the superior fabrics to a small extent in Devonshire, yet such was the demand for foreign laces in these dominions, that Parliament was induced to prohibit the importation of such laces, as it caused a visible diminution in the amount of British specie, and weakened the resources of Britain, whilst it added to the power, wealth, and aggrandizement of France, and the possessors of the Low Countries.

"That the superseding of hand labour by machinery, in the carding and shearing of cotton and other cloths, had been early invented in England, and the use of such carding machinery was prohibited (by the 5th and 6th of Edward VI., cap. 22), on account of its damaging the cloth in the process, from the imperfection of its construction; so that the knitting or stocking frame was the first invention successfully used for superseding hand labour by the use of a machine, in making clothing.

"That in the latter end of the reign of His Majesty George II., or about 150 years after the invention of the said knitting machine, a number of appendages were applied to the said stocking frame, one of which, termed the tickler machine, by mere accident, was applied to the making fabrics in imitation of lace, by removing the stocking loops in various directions. This attempt was succeeded by another invention, termed a point-net machine, consisting of a machine appended to the frame, which made the net without removing the stitches; and this invention, after numerous attempts to make it sound, nearly superseded the making of silk lace by the hand.

"Your memorialists further show that this net, though an imitation of bobbin-lace, was yet inferior in many essential points to those fabrics, particularly in retaining its appearance of lace, when unstiffened; notwithstanding which defect, no less than 1200 workmen were employed at one period in making it, and more than 20,000 persons in ornamenting the net, and preparing it for sale.

"That so early as the year 1770 attempts were made to produce bobbin-nets by machinery, in exact imitation of those made by the hand, having the threads traversed and twisted round each other. To accomplish this object a machine was invented to plat a warp at both ends, in imitation of a machine brought from Switzerland, but this was found too slow a process; small brass winding bobbins, having teeth, and rolling in other rack teeth, were essayed; threads wound upon wire, tier upon tier of hooks, revolving wheels on slides, and hundreds of other experiments were tried, and though the bobbin mesh was by these means effected, yet the want of speed and accuracy of working rendered all the plans abortive. Numerous attempts were made during this period in Scotland, London, and many parts of the kingdom, to make fishing-nets by machinery, which was for several years also essayed at Nottingham. A workman employed in making and inventing such machinery at length discovered, through accidentally seeing a child at play, the formation of the bobbin and carriage now used in the bobbin-net machine, which was first applied to the making of fishing-nets. Notwithstanding this discovery, none of the inventors could apply it to a machine to make bobbin net. So great was the difficulty, and such the number of abortive attempts, that the projectors were ranked amongst the enthusiasts who were seeking to obtain the perpetual motion. Two men, named Simpson and Green, actually died from a disease of the brain, brought on by unremitting and unrequited study.

"At length, in 1809, a machine to make bobbin net was completed, which had passed through the hands of no less than six of the most ingenious and indefatigable mechanics then known, whose labours had been abortive, though they had passed their lives in similar attempts.

"The machine thus accomplished, after 40 years' experiments, in different parts of the kingdom, was yet surprisingly complex and slow in its movements, having 24 motions to the series for twisting the mesh, and four motions for the pins to secure the twist from unravelling.

"This complex machine, before the expiration of the patent, was simplified so as to require only 13 motions to complete the same mesh, and two to prevent the unravelment; two other improvements reduced the motions to 11, and two motions for prevent-

ing the unravelment; and at length the utmost acme of speed was accomplished, by reducing the motions to six, and performing the two motions to prevent unravelment at the same time that the other motions were made; whilst a number of machines to any extent were constructed, so as to be propelled by steam and water power. The original machine only possessed speed sufficient to make one rack, of 240 holes in length, in an hour, while the power-impelled machines can make six such racks in an hour; in addition to which, the original machines made nets from one yard to one yard and a half in width, whereas machines are now made to fabricate net, three, and even four yards in width, thus increasing the speed of the machinery twelvefold.

"To accomplish these surprising improvements, one gentleman has expended the whole of his property, amounting to from 50,000*l.* to 70,000*l.*, whilst others have made similar sacrifices, in proportion to their means.

"That in addition to the improvement upon the principle of the original machine, other modifications of the principle of making bobbin-nets, by the bobbin and carriage, have been accomplished:—by traversing the warp instead of the bobbin-thread; by placing the carriages in a single line, instead of a double line, as in the original invention; all of which improvements or modifications have been made with an immense outlay of capital, and by intense study, care, ingenuity, and perseverance. That in addition to which, though the original machine was only calculated to make plain net in a broad piece, unornamented, yet, by the application of unceasing ingenuity, regardless of expense, various ornaments have been worked into the net by machinery, whilst the net, instead of being made in broad pieces, is worked into slips, exactly imitating the cushion net. The result of making such lace by machinery has been to reduce the foreign cushion lace workers to less than a tenth in number, and England has become a great exporting nation for lace, to the amount of two millions annually, instead of being an importing nation to nearly that amount. Permit your memorialists here to draw your Lordships' particular attention to a recapitulation of the exact position of their trade. Extraordinary study, skill, and invention were applied for 40 years to make the first bobbin-net machine; then continued application for 20 years more has been necessary to bring it to its present degree of perfection. The vast amount of capital sunk during the last 20 years in the machinery now employed, is seen in the incontrovertible fact that, out of the 5000 bobbin-net machines now employed in the English trade, the 3500 machines first constructed, at a cost of two millions sterling, have, by improvements alone, been reduced to the value of 200,000*l.*, leaving the English trade minus 1,800,000*l.* If continental nations succeed in obtaining a sufficient number of our improved machines to supply themselves, which is their present effort and design, no part of the outlay in invention and improvement can ever be regained; and your Lordships will perceive the jeopardy in which these continental rival manufactories will place our trade, in which 2,000,000*l.* is still invested in capital, and 2,500,000*l.* is paid yearly in wages to between 150,000 and 2,000,000 persons."

* * * *

Until the discovery of the bobbin-net machine all lace was made by an appended machinery to the stocking frame. Sixteen descriptions of bobbing-net machines were attempted (and some of them brought to work) previous to Mr. Heathcote's patent in 1809.

An analysis of the whole of the inventions in lace machinery gives the following results:—

Inventions, previous to Heathcote's patent, for making bobbin-net	16
Inventions on the double-tier principle	57
Inventions on the traverse-warp principle	11
Inventions on the pusher principle	16
Inventions on Levers's principle	28
Inventions to make fender-net, called loop-net	3
Inventions to make foreign cushion-net by machinery	6
Inventions on the double set of carriage principle	4
	121

The number of inventions in warp lace are not quite so numerous, but they are equally important.

The invention of the thread-carrier in 1789 more than doubled the speed of the loom and the stocking-frame, and is regarded as the foundation of the fly-shuttle and other momentous improvements in manufacturing skill.

The following are modes of work of fabricating lace and frame-work knitted manufactures, introduced from foreign states:—

1. Round-fingered gloves from Madrid in Spain.

2. Tuck-ribs from Lyons in France.

3. Plated plain work from Nismes in France.

4. Figured warp shawls, the colours worked in on the frame, as practised by Messrs. Hames at Melbourn. From Lyons.

5. Figured-warp handkerchiefs in various devices, by open works, &c. Lyons.

6. Porcupine point-net scarfs. Troyes and Lyons.

7. Sandal open work plain silk shammies. Paris and Troyes.

8. Knotted hose without seam. Lyons and Barcelona.

9. Round feet in hose. France and Spain.

10. Figured-tied silk stockings. Now obsolete. France.

11. Chevening by hand. France.

12. Chevening in gold and silver, as well as silk, on the frame. Lost. From Cordova and Seville in Spain. The trade has now nearly left those places, and has removed to Barcelona, Valencia, Madrid, and Talavera de la Reyna.

The following are inventions used by foreign states, unknown, or at least not practised, in these kingdoms:—

1. Pin machine for making point-net. Lost to the English. France.

2. Trico Berlin machine for making lace in stripes, and to represent feathered work. France, Prussia, Saxony.

3. Cylinder-warp machine to flower the net on the frame. France.

4. Cylinder-tickler machine for making fancy net-hose. France.

5. Machine for working plain stocking-work in coloured figures, the same as knit, by using a number of coloured bobbins, so as to make a representation of flowers, &c. Barcelona and Turin.

6. Machine for making a sort of Brussels lace in the plain silk stocking. Valencia in Spain.

7. *Metier au Griffre*, or frame on two trucks, having no half-jack, and only a top cramp on jack-springs. France.

8. Revolving slur-wheel stocking-frame, which forces down the jacks without a slur-cock for cold countries where jacks would not fall. Denmark, Russia, United States of America.

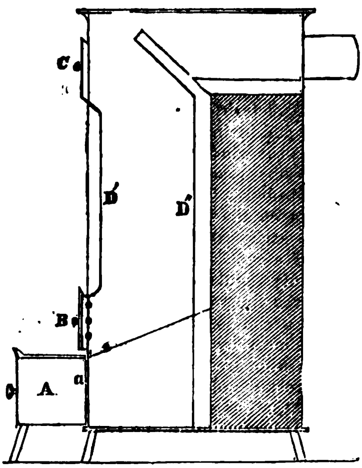
In the preceding enumeration of the various inventions that have been made from time to time, it has been shown that the lace trade has emanated from the stocking frame, as well as the hosiery trade; I have not therefore attempted to dissever the connection existing between them (which locality seems also to aid in perpetuating) by separate descriptions of the improved machinery which now relates exclusively to the one or to the other. Those familiar with either trade will at once discover, and be enabled to make the distinction. It is, however, I think manifest that the popular opinion that the stocking-frame has received no improvement since its first formation is erroneous, and that time has introduced into this machine many important and salutary amendments. Its peculiar characteristic of having escaped the propelling and invincible power of steam, to which even the winds and the waves may be said to have been constrained to submit, has been ascribed to the fact that the varied movements of the body, hands, and legs, which are each called into action in the working of a stocking-frame, are all necessarily mainly regulated and guided by the eye. In the finer work especially, the tax upon this organ is often of great severity, which is shown by the number of middle-aged men who are found using spectacles when at work; and confirmed still further by the fact that, as age advances on the operative, he is invariably found receding from the work of the finer to the coarser gauged frames, long before bodily decrepitude would necessitate the change.

Other and totally different causes may have contributed to discourage any attempt to apply mechanical power to the stocking-frame. If all obstacles to a correct and properly-made article of hosiery by such means could be overcome, it is doubtful whether, in a pecuniary point of view, it would be a measure of economy in the employers to adopt it. While wages remain, as they have done for years past, almost at the minimum of existence to the workman; while custom sanctions, and his defenceless poverty forces him to submit to pay an exorbitant and disproportionate weekly rent for the machine in which he works; while the mode of conducting the business remains in force, which actually prescribes the very limits of the labour he shall perform, as subsequently shown in the practice of stinting; and while at any time the employer can at little sacrifice to himself lay down his one, or his ten, or his hundred frames,—even the rental of the places in which they stand, when at work, being paid by the workmen, there must be great advantages clearly manifested as derivable from any new system of production, which shall preponderate over those yielded by the present one.

THE ARNOTT STOVE ADAPTED TO WORKSHOPS.

Sir,—Wishing to have a stove in my workshop that would keep in all night, and having difficulty in getting coke, I gutted an Arnott stove and built it

up as shown in the following sectional sketch.



A, outer ash drawer; B, a door sliding in a groove, which is only opened a very little, unless a great heat is wanted, when the ash-drawer A is drawn also out, so as to admit air at *a*, which is otherwise closed; C, door for feeding, also running in grooves. The grating is shown behind B. The outer case is of sheet iron, the top of cast. To make common coal burn, the great object appears to me to be, and it is what is accomplished in these stoves, to get the fuel in as immediate contact with the fuel as possible; therefore, the front fire-brick, D^1, should be thin; the sides, D^{11}, are also lined with fire-brick. This stove, although very rudely got up, I have used for two entire winters, and have found it answer uncommonly well. If only its usual heat is required, I feed it at night and morning. If I am going from home, I fill it as full as it can hold with very small coal, very nearly close B, and on my return knock in the top coals, adding a little fresh, admit more air below, when it soon shows symptoms of reviving. In this way I have frequently made it burn up after being away for upwards of fifty hours. I dare say it would not do so with every coal, but ours is very retentive, although it burns fast if air is admitted. In my case there could be no interference, as I took the key with me having carefully locked and barred the shop. The body of brick inside tends to retain the heat, while the iron surface throws it off. An experiment I made was to make the exit for the smoke at the bottom of the back fire-brick or immediately at the back of the fire-bars (of course closing the exit at top as shown in the section); air was then admitted by small holes immediately behind, both from below and at the sides: in this way, Mr. Williams's plan for consuming smoke might be applied. The experiment promised well as to the consumption of smoke, but it required too brisk a fire to last as I wished it; I therefore reconstructed it as I had it before. The result I have given.

I intended to make the grate pull out at B, so as to allow a glue-pot to be boiled, but I find the fewer shifting parts or expedients in any machine the better.

For a regular tradesman's shop the neat thing would be one of these stoves with a properly-supplied boiler at the back in place of the brick work and fire-brick; from this boiler a steam pipe should communicate with the bottom of a sheet-iron press, in which the glue pots might be kept at the best heat, while, by a small addition, any moderate-sized piece of wood could be steamed.

If shavings are to be burned with any heating effect, whatever kind of stove is used, there should be a second iron-box into which the smoke flue should be conducted, thereby accumulating the heat and preventing danger from the flame and sparks.

I may add some remarks on grates at a future opportunity.

Yours, &c.

FORESTER.

June 11, 1845.

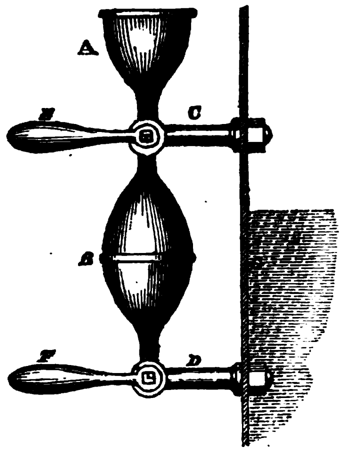
ALLEN'S PATENT PRIMING PREVENTER.

Sir,—I send for insertion in your excellent journal a description of my Patent Priming Preventer, and shall be obliged by your favouring it with an early place.

It is generally admitted, that priming is to be prevented by introducing a good supply of grease into the boiler. The difficulty hitherto has been in finding a ready means of so doing. I think the instrument represented in the following sketch will be found to answer the purpose better than any other yet proposed.

A is the upper grease or oil cup; B, the grease vessel; C, three-way cock, leading to the boiler; E, handle to C;

D, right-angled way-cock connecting the vessel B with the boiler. F, handle to D; G, face of boiler, to which the instrument is screwed.



The mode of operation is as follows: The communication between the grease cup and vessel being open, and all communication with the boiler closed, the grease is put into the cup A, and runs into the vessel B. The cock C is then turned so as to admit the steam into the vessel B, and at the same time to shut off all communication with the cup A. The cock D is then opened, and the contents of the vessel B are forced into the boiler by the pressure of steam from above.

The same instrument may be readily applied to lubricate the packing of D slides, without retarding, or in any way affecting, the progress of the engine.

JOB ALLEN.

20, Bower-street, Commercial-road East, July 20, 1845.

PROSSER AND CARCANO'S IMPROVEMENTS IN WORKING ATMOSPHERIC RAILWAYS.

[Patent dated, December 18, 1844; Specification enrolled, June 18, 1845.]

Messrs. Prosser and Carcano lay claim to three distinct improvements in the atmospheric system, as now in operation on the Dublin and Dalkey line.

First, a mode of working atmospheric railways, "whereby the longitudinal slits or openings in traction-pipes of such railways have longitudinal valves which open inwards, combined with the use of suitable transverse valves or slides at proper intervals for compressed air to press against."

Second, a mode "whereby the use of reservoirs of compressed air is combined with traction-pipes, with longitudinal valves opening inwards, and with transverse slides or valves for the compressed air to press against."

Third, a mode "whereby compressed air is returned back from the traction-pipes into reservoirs."

The manner in which these three improvements are combined in one system of traction is thus explained:—

"The longitudinal valve turns inwards on a hinge, and consists of a long fillet of strong leather, or of other strong flexible substance suitable for such purposes, and the same is strengthened by means of narrow metal plates fixed on the upper side in a similar manner to what has been heretofore resorted to for strengthening the longitudinal valve of the atmospheric railway now at work, and those which are now being constructed. The upper surface of the valve is to be coated with hard grease, particularly at the bearing edges, so that when the valve is pressed outwards by the compressed air within the traction-pipe the joint will be rendered air-tight. The air may, if desired, be at once forced from the pumps used into the traction-pipe, by having suitable connection-pipes between the pumps and the traction-pipe of a railway, in a similar manner (but reversing the action) to that now arranged for railways, where vacuum or partial vacuum is resorted to for obtaining the pressure of the air. But we prefer that there should, at intervals, (in a line of railway which is to be worked according to our invention,) be large reservoirs to receive air from the pumps worked by steam or other power, and that the reservoirs should be connected by pipes with the traction-pipe; and we prefer that there should be three reservoirs at each station, in order that the power employed may be as small as possible, so as by working continuously, both when the trains are moving as well as when they are not moving, the power employed may be as economical as possible; and this arrangement, we believe, will be found generally more advantageous than having large power simply in action when the trains are moving and standing motionless, yet consuming fuel when the trains are not running. The reservoirs will be strong vessels similar to large boilers, and of a strength in proportion to the degree of compression to which the air is subjected therein, which will be varied according to the peculiar circumstances of the traffic and the gradients; but we do not consider it desirable to have the air used in a high degree of compression, though the same allows of traction-pipes of less diame-

ter, as will readily be understood by the engineer. We construct the reservoirs for condensed air each of a capacity equal to the contents of the length of the traction-pipe it is to work with; the valves or slides used between the reservoirs and the traction-pipes being progressively opened, so that the air may be maintained as near as may be at the same density in the traction-pipe at starting as at the end of a section of traction-pipe, for it will be understood that as the air in a reservoir is more dense at starting than at the end, the admission of the air to the traction-pipe should, at starting, be what is technically called "wire-drawn," gradually opening the valve as the air becomes less and less in its pressure in the reservoir. The traction-pipe is divided into sections by valves or slides. We prefer to use flap-valves for closing the traction-pipe transversely, and we enlarge the traction-pipes at those places where such flap-valves are to be used, so that they, when open, may be down out of the way of a passing piston, and when up, that they may have proper seats to press against, and as it is desirable to have the means of travelling in either direction by the aid of the same traction-pipe, we form two inlet valves near together at each place where air is admitted, having the inlet-pipe conveying the air from a reservoir or pump branched so as to enter under these two valves, there being suitable throttle or other valves in the branches of the pipe to determine by which way or branch the air shall enter into the traction-pipe, and according as one or other is open so will the flap-valve above be closed, and the piston will be propelled away from that valve, the valve for the time being across the traction-pipe resisting the air passing in the opposite direction, whilst the other transverse valve will be open, and over the opening where the other branch enters the traction-pipe, by which the piston will be free to pass over that other transverse valve. By thus using flap-valves these transverse valves will close by the pressure of the air, or remain open according as the air comes in at one or other of the branch-pipes, and such flap-valves will not interfere with the passage of the piston in the way it is travelling, as the next valve will not close till after the piston has passed it, for, until that has taken place, the air would not be turned on to close that valve, and press forward the piston. The piston used is similar to that now employed in Ireland on the atmospheric railway, and which is well understood; but there is no apparatus necessary to open or close the longitudinal valve, which we prefer to have so arranged that it will have a slight tendency to fall open to allow of the passage of the instrument which connects the piston-rod with the carriage, as is well understood; but in this case this instrument will precede the piston, the pressure of the air in the traction-pipe closing the valve as it comes up to it, and the air in the traction-pipe before the valve will pass or flow freely out of the traction-pipe through the longitudinal slit or opening. It will, however, be understood that if the tendency of the longitudinal valve to remain open is not sufficient, the flow of air out at the slit or longitudinal opening would tend to close it; if, therefore, it is preferred to have the valve so stiff as to tend to close, then the instrument connecting the piston-rod to the carriage should have a projection sufficiently long to press open the longitudinal valve some distance before the piston, to allow of space for the passage of air from the traction-pipe.

It will be evident that as the section of traction-pipe along which a train of carriages has just been moved, will be full of compressed air, and that such compressed air may be more economically returned back into a reservoir than by pumping from the atmosphere, for it will be understood, that in again filling a reservoir from the atmosphere, the pressure on one side of the pump piston would be the atmosphere, and on the other side the pressure due to the compressed state of the air remaining in the reservoir, and that pressure would be continually increasing, the pressure of the atmosphere remaining constant; whereas if the air be returned from the traction-pipe into a reservoir, the pump piston will commence from a state of equilibrium, consequently requiring comparatively little power, such power increasing as the density of the air remaining in the traction-pipe decreases down to atmospheric pressure; hence, an engineer will readily perceive that, by a suitable arrangement of valves and pipes he may beneficially employ part of the power of the engine for transferring the air from the traction-pipe back into the reservoir. In using this part of our invention, a suitable slide, or other valve, must be caused to close the end of the section of the traction-pipe as the piston leaves it, so that the air may be closed from passing beyond the section if the traction-pipe end there, but where the one section of the traction-pipe is continued by another section, only having a slide, or flap valve between them, then the closing of the next of the transverse valves will be sufficient. This means of working atmospheric railways, like those heretofore proposed, may be used on double or single lines; but we believe that single lines will be generally found sufficient; in which case, the working of the valves and the engines,

and the general working of the railway, will be greatly facilitated by the use of the electric telegraph; and where single lines of railway are preferred, then at stations, where trains are to pass each other, the lines will require to be double, in which cases very little delay will take place between the passing of trains from and to a section of the traction-pipe in opposite ways; for no sooner is one train gone, than at that instant the piston of the other train may enter the same section of traction-pipe, it being understood that, when this instantaneous passing in opposite ways of two trains be desired, then the benefit of using the third part of our invention in those sections of the pipe, will, for the time being, be dispensed with."

ON THE ADVANTAGES OF THE ATMOSPHERIC STATIONARY SYSTEM OF TRACTION AS COMPARED WITH THE LOCOMOTIVE. BY PETER W. BARLOW, ESQ., C. E.

[Abstract of a Paper read before the Institution of Civil Engineers, February 25, 1845.]

The author having been required to examine and to report upon the question of the comparative advantages of the atmospheric railway system, with a view to the propriety of its application to the Tunbridge Wells branch of the South Eastern Railway, and as there appeared to him several results from the use of this mode of traction, which had not apparently been previously noticed, he was induced to lay his investigations on the subject before the Institution, in the hope that they might be found to contain some useful information, although the little time he was enabled to devote to it, prevented his making any very detailed calculations.

In the application of stationary power to traction on a railway, by means of the exhaustion of air in a pipe, several of the inconveniences of the present mode of traction by a rope, are avoided, and the great difficulty of rendering the pipe air-tight, has been in a great measure overcome by the ingenuity and mechanical skill of the inventors. It is but fair to assume, in comparing the atmospheric system with traction by locomotive power, that still further improvements will be made in those features of the invention which relate to the mechanical construction.

Whatever may be the result of the comparison, in a purely mechanical point of view, that is to say, in a comparison of the cheapest and quickest mode of moving certain weights over a given distance, it must be considered, whether the power required on railways generally, is of that uniform character which admits of mathematical computation, and whether, by the adoption of the atmospheric or any stationary power, certain rules and regulations are enforced, which are inconsistent with the ordinary traffic on a railway.

On lines like the Greenwich or the Blackwall Railways, when the traffic is perfectly uniform, consisting of a certain number of trains daily, at stated intervals, the power admits of a mathematical computation; but on railways generally, the power required is liable to considerable irregularities; and a power, which is practically restricted to carrying between certain given points only and at certain intervals, would lead to great inconvenience.

On all railways not carried upon arches, a great deal of work is requisite for maintenance of the road and the works, which must be entirely intermediate traffic, consisting of bringing ballast and other materials to repair the road and works, the removal of slips, &c., and one or more engines are constantly employed for these purposes on all the principal railways. There is also traffic of coal and lime at sidings, to various intermediate points on all railways: and at the principal stations, much manual labour is saved by the locomotive in moving goods, trucks, carriages, &c., from the siding to the main line. The power for this purpose cannot be efficiently applied by the atmospheric system, because it does not admit of traction between intermediate points, except at a cost and inconvenience which would be inconsistent with practice, and must prove an objection to the use of atmospheric or any stationary power. This can be only surmounted by having locomotive engines for this purpose, and it involves a small and consequently expensive locomotive establishment, renders necessary locomotive gradients, and consequently prevents the saving which, it is contended, can be made in the construction of the atmospheric railway, by the use of steeper gradients.

Another practical inconvenience, which will be found in the atmospheric railway, is, that the journey cannot be repeated on a length of pipe until after a given interval, which is necessary for forming the vacuum; the power is, therefore, not always at instant command, and the transmission of special trains and expresses is materially interfered with.

The same objection will also, upon consideration, be found frequently to interfere with the general traffic, at the stations where the up and down trains pass, as it is evident both must wait until the air is exhausted from within the pipes to the next engines. The length of this time will depend upon the extent of the pipe and the power of the

engine; but it could not be less than 6 minutes, which is a serious loss of time to occur at the passing of every train, and on a long line, with trains every half hour, would reduce the average speed to 20 miles per hour. If the length of pipe to each engine was extended to 10 miles, as has been proposed, this loss of time would be more serious, and would amount to 20 minutes or half an hour, unless very powerful engines were used.

Another important objection to the atmospheric railway, is that the traffic is dependent upon keeping air-tight a great length of pipe, and upon the perfect order of a great number of engines; in fact, it depends upon the perfect order of an extensive, delicate, and complicated machine, composed of an infinite number of parts, the failure of any one of which would render the whole machine useless; and it must be evident, to any person practically acquainted with the maintenance of a railway, that the machinery of such an engine will be liable to frequent interruptions, from causes which it would be impossible to control.

The subsidence and slips of embankments and cuttings do not now interfere with the traffic of a railway, unless they are of great extent; because a line of rails, if injured, is soon replaced, in situations where the continuity of the pipe would be destroyed, and the traffic would be intercepted. Slips, which are not of sufficient magnitude to excite public attention, and which, in fact, do not interfere with the trains, are of more frequent occurrence, in wet weather, than is supposed, and will render the maintenance of a pipe, in addition to the rails, not only very difficult and expensive, but in many cases impracticable.

There will also be another source of danger, from increased liability of the carriages to run off the rails of the atmospheric railway. The locomotive, from its great weight, runs over and destroys any impediment which may be on the rails, but which would throw off a carriage. Such impediments, it may be supposed, need not exist; but in spite of every precaution, they are found, in practice, to do so to a great extent. On many railways, cattle are continually run over; tools or planks are frequently left by the workmen on the rails; such things are also frequently put on designedly; stones and flints also fall from the sides of the cuttings upon the rails. Such impediments are thrown on one side, crushed, or run over by the locomotive, but a carriage would be thrown off by them; and by a very small impediment, the traffic on the atmospheric line would be stopped, and serious injury would, in all probability, be done to the pipe and machinery, which would require a considerable time to repair.

These objections to the system may be considered frivolous by those unacquainted with the actual maintenance of a railway; but the uncertain medium by which the traffic is maintained on the atmospheric railway will be fatal to its use for any traffic of importance. A person carelessly or maliciously disposed may, at any time, totally destroy the connexion of the power; and it is well known how frequently this has been attempted on existing railways, and it would be oftener successful, but that the attempts fail from the great weight of the locomotive.

These remarks refer to long lines of railway, but the objections above stated do not apply to short lines like the Greenwich and Blackwall, constructed on arches, and in such situations, unless frequent intermediate stations are required, the system has undoubtedly advantages from its superior quiet and speed, with light trains; and, as will be seen by the following investigation, it will also, in such cases be comparatively more economical.

The question of the comparative cost of haulage, by the stationary and the locomotive systems, was thoroughly investigated, when the locomotive engine was first introduced. It will be seen, that in railways, where the trains are not numerous, the stationary power, in whatever way applied, is worked under a great disadvantage, from the small portion of time which is actually occupied in the passage of the trains on the length assigned to each stationary engine.

The irregularity of traffic on a long line of railway, will be illustrated by the occasional necessity of removing large bodies of troops. The daily average traffic of several of the principal lines, very little exceeds the number of a full regiment of infantry; but it may be necessary to convey several regiments on the same day, and even at the same time; therefore to meet such a contingency, it is evident, the power must be so great as to work at other times at great disadvantage.

The actual lost power, in the locomotive engine, although considerable, is not so much as might be expected, the greater portion of loss being in the power required to convey its own weight and that of the tender; consequently, the amount of lost power is very much greater on lines with bad gradients, than on those with favourable ones, and on steep gradients the atmospheric principle is comparatively more advantageous, in a mechanical point of view.

It is necessary, however, to observe, that a very common error exists in supposing that steep gradients are attended with com-

paratively little inconvenience on the atmospheric railway. They must of course render necessary the additional power due to the increased traction, which makes an important difference both in the first cost and in the working expenses. Thus in the gradient on an incline of 1 in 50, the sectional area of the pipe and the power of the stationary engines will be required to be four times that which is necessary on a level railway, and the working expenses will be increased in the same proportion; in fact, the cost of the apparatus, to give the requisite tractive power on a single line of railway of the above inclinations, would exceed the total cost of a double line, constructed for locomotive power. This result is very much at variance with the statements made in the first instance by the inventors, as to the great saving of cost in the first construction.

The result that steep inclines are better worked by the atmospheric system, has been evidently arrived at without considering the cost of construction, which becomes practically a very important question in the atmospheric stationary power, from the large section of pipe that is necessary. The outlay, as well as the working expenses, will be increased nearly in proportion to the sectional area of the pipe, from the circumstance, that the pressure is limited to that of the atmosphere, and this limitation of the pressure is a great practical objection to the atmospheric system; in fact, in comparing the atmospheric system with traction by the rope, the latter will be found to have much the advantage with steep gradients, and experience will show, that the atmospheric system is practically much better adapted to level lines of railway, than to those with steep gradients, which, if exceeding the inclination adapted to locomotive power, will be worked more advantageously by the rope. There are, however, few instances in which the inclines are required to be so steep, that the locomotive cannot be more advantageously applied; and the fact of the abandonment of stationary power for the locomotive, on the inclines on the Manchester and Leeds railway, and on the Edinburgh and Glasgow (the inclination of both being greater than 1 in 50) as well as in other cases, is not only a proof of the improved capability of the locomotive engine, but of the inconvenience found in practice from stationary power.

The objection which will interfere most sensibly with the adoption of the atmospheric system, is the necessary outlay in the engines and the pipe, and this seems to have been lost sight of in the calculations of the economy of working, which have been made by its advocates.

Referring to the calculations of the cost of working on the London and Birmingham Railway; to lay down the apparatus of a double line, with a pipe of the required area, would not be less than £10,000 per mile, or a total cost of £1,120,000; and the interest of this sum, at 5 per cent., will be £56,000, or £500 per mile, or a sum very nearly equal to the actual cost of working that railway by locomotive power, and exceeding the average cost of most of the long lines. In fact there is no doubt that respectable contractors could be found, who would supply locomotive power, and work any railway, for the interest of the sum which would be expended, in laying down the atmospheric apparatus.

If the interest on the necessary additional outlay is equal to the cost of working by locomotive, it is evident that it cannot be applied to main lines already executed, even if the working expenses were entirely saved.

It has been stated, that an economy may be effected in the cost of the construction of the tunnels and the bridges, by avoiding the use of the engine; but this is erroneous, as the dimensions are governed by the size of the goods' trains, the carriages and the trucks, and not by the engine.

A calculation has been made, showing a reduced cost of maintenance of the permanent road; but experience has shown, that in this department any calculation must be so completely vague, as to be totally without practical utility.

The chief cost of maintenance of way on ordinary lines, is from the settlement of the embankments; and on new lines it is sometimes extremely difficult to prevent an interruption of the traffic, during the winter, from the sudden and irregular settlement which a few hours may produce. On recently made embankments, it would be found extremely difficult to keep in order the road with the atmospheric pipe, and it could certainly only be done at a very increased cost.

It may be argued, that as the weight of the engine running over the road is avoided, less repair will be necessary. In cuttings, some saving might be expected from this cause, if there was no pipe in addition, but with this addition, and on a line with the ordinary proportion of embankment, it is to be apprehended that the cost of maintenance will become a serious expense.

From these observations, the following general results have been arrived at:—

1st. That the situations best adapted for the application of the atmospheric principle, are on lines where the trains are required to be numerous. This must generally occur near towns, and in such cases, additional advantages would be derived from the absence of the noise of either the locomotive

or the rope, and such lines might also generally be constructed at less cost by the adoption of this mode of working, so as to pay for the additional expenditure.

The circumstance of a railway being throughout on one inclined plane, so that the carriages will run down with their own gravity, as on the Dalkey line, is favourable to the atmospheric system.

The locomotive system would, however, also derive advantage from the same cause, as the engine would return without using any steam.

2ndly. That on any main line, with the average number of trains, the interest on the cost of the atmospheric apparatus amounts to the present actual annual cost of working by locomotive, and consequently, it cannot be applied to any line or branch worked as part of the same locomotive establishment, without an actual annual loss, amounting to nearly the whole cost of working the atmospheric engines.

It must also be evident, that it can never be applied to new lines, under ordinary circumstances without actual loss, as no reduction in the cost of the pipe can be made by the alteration of the gradients. If the mode of rendering the pipe air-tight could be improved, so as to work lengths of 10 or 15 miles each with one engine, it would much reduce the loss of power; but these lengths would cause several practical inconveniences if they could be obtained.

3rdly. That a great cause of lost power arises from all modes of working a railway by stationary engines, inasmuch as the steam must be kept up the whole 24 hours; while the locomotive power is practically required for a few hours only. This will amount, assuming the average number of trains on railways, to three or four times the consumption of fuel by the stationary principle. It may be said, that when applied to long lines, a greater number of small trains would be run, instead of a few large ones; and this would certainly be the best plan. How far the increased traffic, arising from these facilities, might pay the additional cost, it is impossible to say; but with any number that can be run with advantage, the locomotive would be the least expensive method, unless under peculiar circumstances. There is also another objection arising from the amount of work which is required to be done at stations by locomotives, and also the intermediate work of various kinds, this, with the atmospheric system, must be done by horse or manual labour at a much increased cost.

There is also the risk of certain stoppages of the traffic with the atmospheric railway, not only from the stationary engines getting out of order, but from the frequency (with every care that can be employed) of obstacles on the road, which will throw a carriage off the rails; injury to the pipe, by slips and subsidences, &c. These are of frequent occurrence in embankments, and in a common road they can be repaired in a few hours, but they would be sufficiently extensive to entirely destroy the action of the pipe, and would stop the traffic for a considerable period.

4thly. The most favourable feature in the atmospheric plan is the advoiding the noise, both of the locomotive and the rope, and this will lead to its adoption on short lines in the neighbourhood of towns, as it will be the less objectionable to the residents in the neighbourhood; and in these case, as the trains are required to be numerous, and locomotive power on the small scale becomes comparatively costly, the advantages of economy will also be in its favour; in other words, in such cases, where stationary power has or may have been previously used with economy, the atmospheric mode of traction would be advantageous; but whatever improvements may be made in its construction, it must still possess the essential features of the stationary principle, and must therefore, as has been previously shown, not admit of application to a railway of general traffic.

The attainment of lengths of 10 miles each would evidently reduce the great cause of loss of power in the present atmospheric railway; but it would increase the inconvenience which must arise on long lines, from the absolute necessity of intermediate power, and where two trains meet, it is evident they must both wait, during the time the air is exhausted out of 10 miles of pipe, which will not be less than 20 minutes or half an hour, unless stationary engines of very large power be used.

The result, as to the effect of the resistance of the air at high velocities, is very interesting. It has been shown by experiments, that when a train attains a velocity of 35 miles per hour, the resistance from this cause equals 50 per cent. of the tractive force, and that it increases rapidly with higher velocities; this is fully proved by the effect of windy weather on passenger trains; but it is remarkably illustrated by a circumstance which occurred on the Canterbury and Whitstable railway, since it has been under the author's charge (and it appears to have been of frequent occurrence). A train was entirely stopped in descending a gradient of 1 in 50, rendering it necessary to use horse power, although the velocity of the wind at the time could not have exceeded 60 or 70 miles per hour.

The result arrived at, that the average

speed on a single line would be reduced to 16 miles per hour in practice, from the pipes being full, at the meeting of the trains, confirms the author's estimate of 20 miles per hour; and it appears also to be shown so clearly as to admit of no doubt, unless the advantage of frequent trains be abandoned. It is impossible, therefore, not to look with great interest on the experiment of the South Devon line, where it is anticipated that more than double that speed will be realized.

With reference to the lines on which the atmospheric system is in course of execution, viz., the London and Croydon, and South Devon, the results arrived at in the above investigation show, that the London and Croydon (if not forming a portion of a trunk line), is a case in which the power can be comparatively applied with advantage, and the objections only apply to a limited extent, as the trains are frequent, and the traffic consists chiefly of passengers, and as there need be only one train met, the speed with a single line will probably be greater than with the locomotive engine, from the time necessary with frequent stoppages, to get the locomotive engine up to its speed.

The New Cross incline will be felt to be the greatest objection, as the speed will be small (with the power proposed), with large trains, from the increased tractive force which will be necessary.

The South Devon line is a case, to which it would appear from the above results, that the atmospheric system is not adapted.

[The discussion which followed the reading of this Paper we shall give in a subsequent number. Ed. M. M.]

CASE IN RAILWAY ENGINEERING.

There are three towns, A, B, C, communicating by railway, all situated on the same level plane, but not in the same straight line with each other: between these towns the mutual distances are as under, viz.:

From A to B............	25 miles
From A to C............	31 ,,
From B to C...........	22 ,,

At 12 miles distance from A in a straight line is a station of supply, at which the branches to B and C diverge. Now, since it was optional with the engineer to place that part of the trunk line between A and D in any position he pleased—what would have been its position with respect to the branches D B and D C, and what would have been the lengths of these branches, had they been laid down in such a manner, as to form jointly the least length possible?

PROFESSOR PAGE'S MAGNETO-ELECTRIC MACHINE.

In 1838, Professor Page published in Silliman's Journal an account of an improved form of Saxton's magneto-electric machine, doing away with many existing objections, and furthermore rendering it at once a useful instrument, by a contrivance for conducting these opposing currents into one channel or direction, which part of the contrivance was called the unitress. The current produced in this way was capable of performing the work, to a certain extent, of the power developed by the galvanic battery; and the machine was found adequate to furnishing of shocks for medical purposes, for exhibiting the decomposition of water, furnishing the elements of oxygen and hydrogen at their respective poles, and producing definite electro-chemical results. These two last results could not be obtained without the aid of the unitress. But, with this improvement, the instrument was still wanting in one property of the galvanic battery—viz., that property which chemists call quantity, or that power upon which depends its ability to magnetize, and also to heat platinum wires. This last property has been given to the machine by the recent contrivance of Professor Page. The machine, in its novel construction under his improvement, developed what is called by way of distinction, the current of intensity, but had a very feeble magnetizing power. By a peculiar contrivance of the coils, (not to be made public until his rights are in some way secured,) the current of quantity is obtained in its maximum, while at the same time, the intensity is so much diminished that it gives scarcely any shock, and decomposes feebly. It has been successfully tried with the magnetic telegraph of Professor Morse, and operates equally well with the battery. It affords, by simply turning a crank attached to the machine, a constant current of galvanic electricity; and as there is no consumption of material necessary to obtain this power, it will doubtless supersede the use of the galvanic battery, which, in the event of constant employment, would be very expensive, from the waste of zink, platinum, acids, mercury, and other materials used in its construction. It particularly recommends itself for magnetising purposes, as it requires no knowledge of chemistry to insure the result, being merely mechanical in its action, and is always ready for action without previous preparation; the turning of a crank being the only requisite, when the machine is in order. It is not liable to get out of order; does not diminish perceptibly in power when in constant use, and actually gains power when standing

at rest. It will be particularly gratifying to the man of science, as it enables him to have always at hand a constant power for the investigation of its properties, without any labour of preparation. We notice among the beautiful results of this machine, that it charges an electro-magnet so as to sustain a weight of one thousand pounds, and it ignites to a white heat large platinum wires, and may be used successfully for blasting at a distance; and should Government ever adopt any such system of defence as to need the galvanic power, it must supersede the battery in that case. Professor Page demonstrates, by mathematical reasoning, that the new contrivance of the coils affords the very maximum of quantity to be obtained by magnetic excitation.—*Report of American Commissioner of Patents for* 1844.

NOTES AND NOTICES.

The "satisfactory" Janus.—The *Times* of Thursday last, in giving an account of a visit of the Lords of the Admiralty to Chatham, states, that their lordships, after inspecting the Dockyard, "proceeded on board the *Janus* steam sloop, and proceeded under steam down the river, followed by the *Black Eagle* Admiralty steamer. *The rate of the speed of the Janus was about three miles an hour, the wheels revolving about five times in a minute.* On its arrival at Gillingham-reach, their Lordships seemed to have had enough of the vessel, for they left it, and proceeded on board the *Black Eagle* to Sheerness."

Ice-land transformed into Sun-land.—M. Gaymard read to the French Academy of Sciences, at one of their recent meetings, a letter which he has received from Reykiavik, in Iceland, informing him that for an entire year there had been beautiful weather in that island, and scarcely any winter. The summer of 1844, and as much of the present summer as had passed, have been delightful. The meadows are in the finest possible state, and the fisheries highly productive.

Cotton spinning in America.—The *Boston Transcript* says, "The new cotton-spinning frame, just put into operation at Lowell, we understand, is creating quite an excitement among manufacturers. It is said to require but one half the power, and will make more yarn, and of more even twist, at about two-thirds the expense of the other kinds of frames in use."

An American Locomotive—Poor Oliver Evans's prophecy is being more than realized, concerning the rapidity of transmission by railroads. Perseverance, inventive genius and mechanical skill have fashioned that strong propelling power, the locomotive engine, to almost a state of perfection, and little remains to be done, it would seem, to add to its usefulness, or increase its strength. Of recent date in their invention, their progress to enlarged usefulness has been almost as rapid as their flight from point to point; and what was but a few years ago a comparatively slow-moving, ill-constructed machine, now starts upon its errand with a rapidity and a precision of movement, that seems almost instinct with life. We thought something like this, on Saturday, when looking at a powerful engine, called the "Jacob Little," which was brought down from the city railroad, from Mr. Norris's manufactory, for the purpose of being shipped to the Long island railroad, upon which it is to travel. We were informed that it was built with the purpose of carrying three hundred passengers and the United States mail from Brooklyn to Greenport, (L.I.) a distance of *ninety-seven* miles in *two hours and a half!* and we are assured that the machine could accomplish it in two hours only—a rate of forty-eight miles an hour. Certainly this is speeding upon the wings of the wind. The arrangement of the locomotive differed from others we have seen. In front, the usual four wheeled iron truck, played upon a pivot to permit a free undulatory motion, and next them was a single pair of driving wheels of the unusual dimensions of five feet ten inches in diameter—These two driving wheels supported five sixths of the weight, and immediately behind them under the engine's platform was a pair of small wheels of the same diameter of those of the truck, which bore the remaining sixth of the burden. The relief wheels were not geared to the large driving wheels. The diameter of the cylinder was ten and a half inches, the length of stroke twenty inches, and the whole weight of the Engine almost fourteen tons.—*U. S. Gazette.*

LIST OF PATENTS GRANTED FOR SCOTLAND, FROM THE 22ND OF JUNE TO THE 22ND OF JULY, 1845.

Robert Addison, of Regent-street, Middlesex, piano-forte manufacturer, for improvements in piano-fortes. (Being a communication from abroad.) Sealed, June 23.

Charles Smith, Newcastle-street, Strand, London, gent., for new and improved methods in the construction and application of a variety of cooking, culinary, and domestic articles and utensils, some of which are applicable to cleaning and a variety of similar useful purposes. June 24.

James Johnston, of Willow-park, Greenock, Esq., for new and improved processes in, and machinery for, making and refining sugar. June 26.

Auguste Cherot, of Nantes, France, spinner, for certain improvements in machinery for spinning flax, hemp, and other fibrous substances. (Being a communication from abroad.) June 30.

Charles Wheatstone, of Conduit-street, Middlesex, Esq., and William Fothergill Cooke, of Kidbroke near Blackheath, Kent, Esq., for improvements in electric telegraphs, and in apparatus relating thereto, part of which improvements are applicable to other purposes. July 3.

David Gavin Scott, of Cromwell-park, Perth, for an invention by which the heddles of a loom are moved to produce various patterns on woven fabrics. (Being a communication from abroad.) July 4.

James Kite, of Hoxton, Middlesex, coal-merchant, for certain improvements in constructing chimneys, and in the means used for sweeping the same, part of which improvements are applicable to other like useful purposes. July 4.

Patrick Sandeman, of Greenside-place, Edinburgh, for improvements on coffins. July 9.

William Mather and Colin Mather, of Mather Salford, Lancaster, engineers, for certain improvements in boring earth, stone, and subterraneous matter, and in the machinery, tools, or apparatus applicable to the same. July 10.

Henry Pinkus, of Mount-street, Grosvenor-square, Middlesex, Esq., for improvements in obtaining and applying motive power in impelling machinery. July 17.

Joseph Amesbury, of Devonshire-street, Portland-place, surgeon, for improvements in apparatus for the relief or correction of stiffness, weakness, or distortion in the human body. July 18.

Thomas William Gilbert, of Limehouse, Middlesex, sailmaker, for improvements in the construction of sails for ships and other vessels. July 18.

Alexander Wright, of South Lambeth, Surrey, for improvements in gas meters. July 21.

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

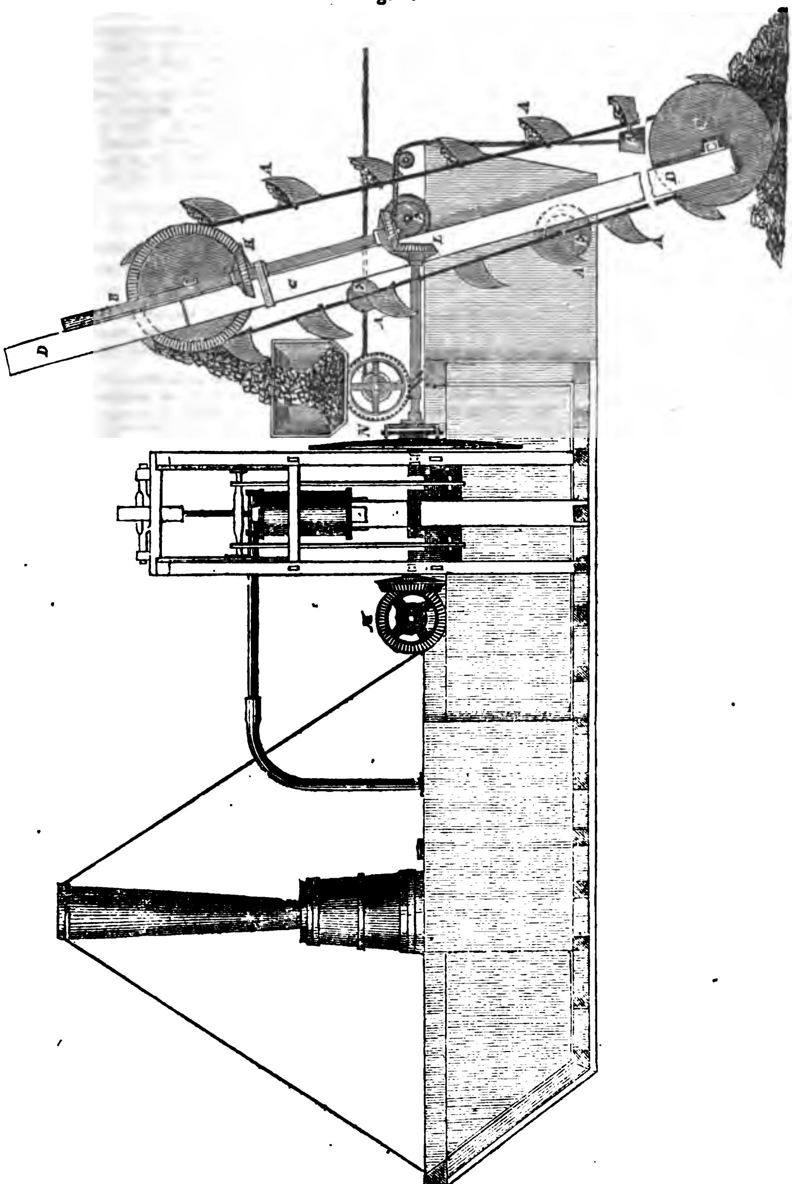
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1150.] SATURDAY, AUGUST 23, 1845. [Price 6*d*.

Edited by J. C. Robertson, No. 166, Fleet-street. Double.

Fig. 2.



THE STEAM DREDGING MACHINE—NARRATIVE OF THE CLAIMS OF SIR SAMUEL BENTHAM TO ITS INVENTION.

Sir,—In Vol. xxxix. of your Magazine, p. 309, was given the history of the dredging machine, extracted from Part I. of Weale's "Quarterly Papers on Engineering," in which it is stated that the late Mr. Rennie was the first to propose and construct a dredging machine,* to be worked by steam power. "In the year 1802, the late Mr. Rennie, in his Report to the Hull Dock Company on the best mode of improving the docks, proposed applying the six-horse engine, then employed for driving the piles of the coffer-dam of the entrance, to the old dredging machine of Grimshaw. . . . The machinery was fixed in a barge 61 ft. 6 in. in length, and 22 ft. 6 in. in width, and draught of water 4 feet; it worked in a depth of 14 feet until the year 1814, when various alterations were made in it under the direction of the late Mr. Rennie, who caused the six-horse engine to be erected in it in the year 1804—after which it raised from 20,000 to 23,000 tons of mud per annum, at a cost of about threepence per cubic yard, from a depth of 22 feet." It therefore appears that Mr. Rennie's machine, for which priority is claimed, was *proposed in* 1802, *and erected in* 1804; what follows will, however, show that the late Sir Samuel Bentham, in the year 1800 (*two years before Mr. Rennie*) invented and recommended such a machine to the Lords Commissioners of the Admiralty, which recommendation having been approved of, it was made, and being completed by April 1802, (*two years before Mr. Rennie's*), was put to work, and found fully to answer the purpose for which it was constructed.

As so much discussion has arisen as to whom the merit of this important invention is really due, I trust that the following details collected from official documents, most of them existing at the Admiralty, together with a description of the machine, and reduced copies of the original drawings from which it was constructed, will be found acceptable to your readers.

It appears, that as early as the year 1799, Sir Samuel Bentham had directed his attention to this subject, and having collected data on the system of dredging then in use, subsequently devised a machine for performing the operation more speedily and economically; and in the early part of 1800, he addressed the following letter to the Admiralty upon the subject:—

"Portsea, April 18, 1800.

"Sir,—Among the various inconveniences to which his Majesty's several naval establishments appear to be subject, no one local circumstance seems to cause so much hindrance to the business of them as that of the want of a sufficient depth of water at the wharfs, and other parts of the harbours, contiguous to which these establishments are placed. I have, therefore, been led to consider the laborious operation of digging up ground from under water, as affording an instance in which the introduction of machinery, to be worked by a less expensive force than that of manual labour, would be productive of the most extensive utility.

"The apparatus used by persons under the direction of the Trinity House, seems as well adapted to the digging up ground under water as any engine to be worked by manual labour can be expected to be; but the effect of such an apparatus is so inconsiderable, that the attempts of clearing away by these means some particular shoals in the river Medway have been given up, and though a similar apparatus is, from necessity, now used in Portsmouth harbour, for the purpose of keeping clear the jetties, as well as the entrances to the docks and basins; yet, as the expense of the manual labour alone, for the doing the little work of this kind that is done there, amounts to about 1,400*l.* a-year, being at the rate of 2*s.* 6*d.* per ton, I could not venture to propose the undertaking any considerable works for the improvement of the harbour by any such expensive means.

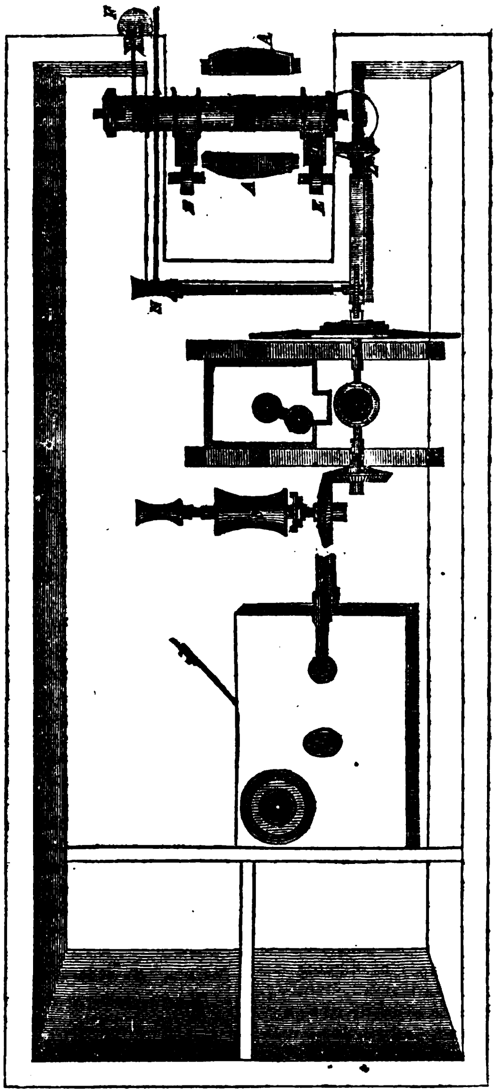
"At Hull, as well as in Sweden and in Holland, an apparatus for digging up ground from under water has been worked ith great effect by means of horses; but he force of a steam-engine being mate lly cheaper, as well as more convenient, s ms far preferable for any such work as this.

"By a well-contrived apparatus for his purpose, worked by a steam-engine, I am of opinion that, at a very moderate expe se, not only all shoals formed by a gra ual accumulation of soil, may be cleared a ay, to the great benefit of rivers and harb urs

* That is, a dredging machine with buckets, Messrs. Boulton and Watt having only applied the steam-engine to the old spoon machine.

in general; but, likewise, that deep water may be brought to the wharf walls of the dock yards, and other naval establishments, so as that, in most cases, the expense of forming jetties, which would otherwise be necessary for the purpose of projecting the wharfs out into deep water, may, according to the nature of the soil, be altogether saved, or, at any rate, may be very much diminished.

Fig. 1.



. further use to which a well-condu ed apparatus of this kind might be made ap icable, is that of diminishing very materia y the expense of forming new ground on fla now covered by the tide, as in the instance of the great addition which is now making to the gun-wharf here. By such an apparatus, the shingle, or other soil dug out from the harbour, might be deposited so as to raise the new ground above the

height of even high water mark, without the assistance of manual labour for any other purpose than that of transporting the vessels loaded with the soil to and fro.

"I have for these reasons been induced to bestow a good deal of attention in the contriving an apparatus for the digging up, removing away, and depositing ground, according to a variety of local circumstances, and would, therefore, take the liberty of proposing, that my Lords Commissioners of the Admiralty would be pleased to give directions for the preparing such an apparatus for the use of Portsmouth Harbour, where the want of it seems most pressing.

"The expense, as near as I can estimate it, would be as follows:—

	£	s.	d.
"For the millwright's work, including the steam-engine and other machinery, adapted to raise about 1000 tons of soil a day	1,200	0	0
"For a vessel on which the machinery would be fixed, as well as for others adapted to the carrying away the soil, and depositing it either out in deep water, or on new made ground........	3,500	0	0

"In case their lordships should approve of this proposal, I would request that they would be pleased to authorize me to cause the machinery to be prepared immediately, under the direction of Mr. Goodrich, the mechanist; that with respect to the vessels, the officers of this Dockyard should be directed to take my instructions respecting them; and that they may be built in the Dockyard, or by contract in the neighbourhood, as may appear most economical.

"I am, &c.,

"S. Bentham.

"To Mr. Secretary Evan Nepean."

To this letter the following reply was received:—

"Admiralty Office, April 23, 1800.

"Sir,—Having laid before my Lords Commissioners of the Admiralty your letter to me of the 18th instant, proposing that directions may be given for preparing an apparatus for the purpose of digging up ground under water in Portsmouth Harbour, I have their lordships' commands to signify their direction to you to furnish them with drawings of the machinery and vessels which you propose should be constructed for the purpose above-mentioned.

"I am, Sir,

"Your most humble servant,

"Evan Nepean.

"General Bentham."

Sir Samuel Bentham accordingly furnished the plans and estimates required, as appears by the following letter:—

"Portsea, May 13, 1800.

"Sir,—In obedience to the commands of my Lords Commissioners of the Admiralty, contained in your letter of the 23rd ult., I herewith enclose a plan, section, and elevations of the vessel and machinery proposed for the digging and raising of soil from under water, as also plans, sections, and elevations of the barges proposed for depositing the soil under different circumstances; and as the economical execution of various important works depends on the bringing this apparatus into use,* I would request that, in case their lordships should be satisfied of the expediency of it, they would be pleased to give me authority for the preparation of the machinery accordingly, and that directions may be given for the building of one of each of the vessels in this Dockyard, after which a greater number may be built, either there, or by contract out of the yard, as may appear most economical.

"I am, &c.,

"S. Bentham.

"Evan Nepean, Esq."

The matter having been taken under consideration by the Lords of the Admiralty, Sir Samuel Bentham's suggestion was approved of, and he received the following official communication upon the subject:—

"Admiralty Office, July 30, 1800.

"Sir,—My Lords Commissioners of the Admiralty having referred to the Navy Board your two letters to me of the 13th and 20th of May last, respecting an invention for digging up and carrying away soil from under water, I have their lordships' commands to send you herewith a copy of a letter which I have received from the Navy Board, for your consideration; and to desire you will let me know, for their lordships' information, if the engine therein alluded to can in this instance be brought into use.

"I am, Sir,

"Your humble servant,

"Evan Nepean.

"Brigadier-General Bentham."

The following is the letter from the

* So convinced was Sir Samuel Bentham of the value of the new machine as to saving useless expense, that he wrote to General Ross (20th August, 1801), then directing the Ordnance works at Portsmouth, recommending that the works on the south side of the gun wharf (mentioned in the proposal to the Admiralty) "should be desisted from for the present, until the machine which is now making for digging soil under water be completed."

Navy Board mentioned in the preceding letter.—

"*Navy Office, 29th July*, 1800.

"Sir,—In return to your letter of the 25th inst., enclosing two from Brigadier-General Bentham, on the subject of his invention of a plan for digging up and carrying away soil from under water; and signifying to us the directions of the Right Hon. the Lords Commissioners of the Admiralty to consider and report our opinion on the plan in question:

"We request you will acquaint their lordships we have considered the plan; and, concluding that General Bentham has made his calculations and estimate upon the experience he may have had of similar works, we are of opinion that such a machine, possessing the power of raising 1000 tons of soil in twelve hours, as mentioned in the plan, would be very useful for the purpose intended.

"At the same time it may be necessary to inform their lordships that there is a steam-engine at Deptford yard, which was returned into store after Lord Stanhope's experiment on board the *Ambi-Navigator*, which has been paid for out of the public money, to the amount of 4,498*l*., and which may perhaps be brought into use upon this occasion.

"We are, &c.,

"A. Hammond. W. Palmer.
J. Henslow. H. Harwood.
Wm. Rule. G. Gambier."
G. Marsh.

In consequence of this letter, the Admiralty requested to know whether the steam-engine mentioned by the Navy Board could be made applicable to the machinery; and on the 15th of October ordered "the ballast-heaving machine" to be carried into execution, applying such part of Lord Stanhope's steam-engine as could be adjusted.

Mr. Lloyd, of Little Chapel-street, Westminster, having undertaken to furnish the machinery, and fix it on board the vessel, for 1640*l*., a contract was entered into between him and the Navy Board, and its construction proceeded accordingly, under the direction of Simon Goodrich, Esq., the mechanist in the Inspector-General's Office; and this gentleman, in a letter dated the 4th April, 1802, informs Sir Samuel, that "the ballast-heaving machine seems completed as far as required by Mr. Lloyd's contract, but we have not made a particular survey of it. It is proposed to put it in motion on Tuesday, supposing you will be here to see it work."

It had, however, been tried before the 4th of April, as appears by the following letter from Mr. Diddams (acting as Master Shipwright at Portsmouth), in which he gives instances of the quantity of coals used at different times for the dredging machine:—

"*Portsmouth Yard, 7th Sept.*, 1803.

"Sir,—Agreeable to your desire, I send you an account of coals expended in the digging engine:—

"1802.

March 6 ..	1 chaldron.	Used in making trial of the engine.
April 3....	1 ,,	Used in *raising soil.*
August 3 ..	1 ,,	
&c.	*&c.*	*&c.*

"I remain, &c.,

"N. Diddams."

Much use, however, was not made at this time of the Ballast-heaving Machine, on account of dock-yard difficulties in obtaining men to work it; for a letter dated October 6, 1802, shows that it was contrary to the dock-yard regulations "to employ scavelmen or labourers on service afloat;" and obstacles of a different nature likewise occurred, which Mr. Tucker (Secretary to Lord St. Vincent) alludes to when he writes (July 7, 1802): "How does your floating steam engine answer or promise? as I have its *battle to fight now and then*; and it proves to be much wanted at Woolwich, where it was with the utmost difficulty they could get the *Albion* to the dock." Indeed Sir S. Bentham experienced great opposition in introducing most of his new machines, as well as all his improvements in general into the several dock yards.

The machine was nevertheless again at work in December of the same year; and Mr. Diddams gives the following report of its performances:—

"December 13, 1802. The steam engine vessel worked at the north part of the yard on a bank of shingle ballast, into which a staff of 1½ inches would not penetrate more than 8 inches by the force of a man, and the buckets brought up shingle at the rate of 1 ton 6 cwt. per minute.

"Depth of water when at work 14 feet.

"December 15, made another experiment in the Ordnance Lake Channel, the bottom of which was hard blue clay, with a mixture of shingle, into which the staff of 1½ inches at some places would not penetrate, and at no

place more than 5 inches by the force of a man. Here the buckets brought up at the rate of 1 ton 8 cwt. per minute, and at one period of the experiment with the full power of the engine employed brought up in one minute 2 tons 4 cwt. Depth of water 16 feet."

In 1803, it was almost constantly at work, for Mr. Diddams, in one of his accounts of soil raised (Sept. 2, 1804), from the 4th of April, 1802, to the 2nd of September of the same year, mentions 61 days on which the dredging machine was at the victualling quay and gun wharf.

The dredging machine having been thus fully tried and found to answer so satisfactorily its purpose, Sir Samuel Bentham officially announced its completion to the Lords of the Admiralty in the following letter :—

"Portsea, June 28, 1803.

"Sir,—I have now the satisfaction to state for the information of my Lords Commissioners of the Admiralty, that after repeated experiments, the floating engine for digging under water has been found fully to answer its intended purpose, since when there has been no impediment in the way, it has taken up at the rate of 2 tons of soil per minute; and in cases where the scoops have been suddenly stopped by the laying hold of a stump of a pile, or other unyielding body, no damage has ensued to the engine.

"It has become evident, therefore, that, by means of such engines, the depth of water at the jetties and wharfs of the dock yards and other naval establishments may be increased; many shoals which obstruct the navigation of harbours may be cleared away, and basons and other excavations for the reception of ships may be dug out at an expense which the advantages to be expected from such works may justify; whereas, although there are several desirable works of this nature which have been designed by others as well as by myself, I never could venture to recommend the execution of them, while there were no other means of effecting it than by manual labour.

"For the use of Portsmouth Harbour, where there are several great works which their lordships may perhaps think it advantageous to execute by means of such engines, there will probably be occasion for five or six of them, and independently of any such great works, I would recommend that there should be at each of the dock yards one such digging vessel, with two or three mud barges, for the purpose of deepening the wharfs and moorings, and keeping them clear of sullage.

"Previously, however, to the ordering any such number of these digging vessels, as it cannot be expected that an invention of this nature should, in the first instance, have been brought to the state of perfection of which it is susceptible, and particularly as I have great hopes, that by the adoption of a new kind of steam engine lately introduced by Mr. Trevethick, the apparatus altogether may be simplified and rendered less expensive, I would venture to propose, that one other digging engine only should be proceeded with immediately, and accordingly, should it meet their lordships' approbation, I should further propose that I may be authorized to procure the machinery for another digging vessel as soon as possible, together with a steam engine on Mr. Trevethick's plan for working it.

"I am, &c.

"S. Bentham.

"Sir Evan Nepean, Bart."

In this letter, Sir Samuel hints at the practicability of applying one of Mr. Trevethick's engines to the dredging machine, and when in the latter part of 1803, a second machine was ordered to be constructed for Woolwich Dock-yard he proposed its application, "but as a steam engine on this principle erected in that neighbourhood had unfortunately blown up since that time, by which accident several men were killed, and much damage done to the adjacent buildings;" although it arose, "partly from bad management in the working the engine, and not from any immediate defect in the principle on which it was made, yet as the accident happened at Greenwich, and as the prejudice against engines of this kind is consequently become very strong in that neighbourhood," he did not, "under this circumstance, think it advisable to introduce one of them into Woolwich Dockyard;" and he therefore proposed, in the stead of Mr. Trevethick's steam engine, to employ one of the usual construction.

The priority of Sir S. Bentham's application of steam power to the dredging machine being fully established by the foregoing correspondence, I shall now pass on to describe the machine itself; and in doing this, I shall point out the particulars in which it differed from the machine as at present constructed. It is represented in the figures 1, 2. Fig. 1 is a plan, and fig. 2 a sectional elevation. The vessel in which the machinery was placed, consisted of a flat-bottomed barge

of a rectangular form, about 50 feet long, 23 ft. wide, and 8 ft. deep; in the stern of which there was a recess 8 ft. wide, and 10 feet deep, for the reception of the endless chain and buckets, which worked in the centre of the stern of the vessel. The bucket chain was somewhat different in its details form that in the later machines, in which it is usual to have the bucket attached to a separate link, and a connecting link between them; but in this machine the latter was not employed, the link to which the bucket was attached being of sufficient length, viz., 4 feet, to reach to the bottom of the next bucket.

Fig. 3.

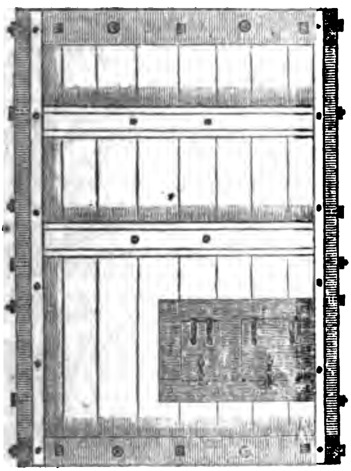
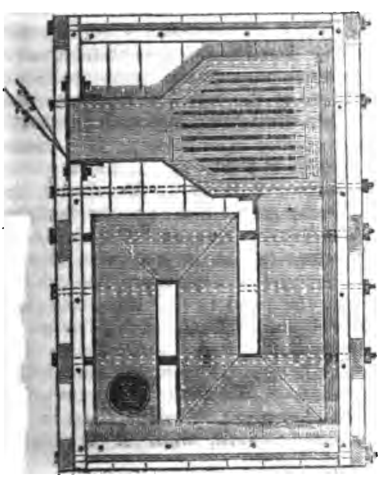


Fig. 4.



The buckets, A A, twenty-one in number, were of iron, 4 feet long, 18 inches deep, and 15 inches wide, and contained about 7 cubic feet of soil. The top and bottom tumblers, B and C, were both the same size, and four-sided; they were attached by plummer blocks to the timber framing, D D. It will immediately be seen by an inspection of the engravings, that the manner in which the bucket frame was raised or lowered in this machine is totally different to that in ordinary use; for in place of having the framing turning on an axis at the upper end, and raised or lowered by a tackle at the other, it moved up and down parallel with itself, being kept at the proper inclination by the guide wheels, E E, and supported at the requisite depth by a rope passing round the axle E′—a rope attached to the counterpoise weight, F, being wound round in the contrary direction.

The motion was transmitted from the steam engine to the tumbler B, by means of the bevel wheels, L, K and H, and to allow of the bucket frame being raised or lowered, the bevel wheel, H, was not keyed upon the shaft, but could slide up or down with the frame, being always kept in gear with the bevel-wheel on the tumbler-shaft by a stop, G. As the soil was removed, the machine was gradually wound forward, at the rate of about 2 feet per minute, by means of the drum N, in connection with the engine; there was also a large drum, M, for the purpose of moving the machine from place to place. The steam engine, which was a crosshead engine with double-connecting rods, was of 12-horse power.

Figures 3 and 4, show the details of the boiler, which is here given, in consequence of its peculiar construction being composed in a great measure of wood. From the detailed nature of the engravings no particular description will be required, but the following extract from a letter written by Mr. Simon Goodrich (under whose direction it has previously been stated the dredging machine was constructed) to Sir S. B., dated September, 19, 1827, will be interesting, as showing how durable the wooden boiler was found: "In respect to our wooden boilers, which he (Mr. Strutt, of Derby,) seemed incredulous about, perhaps you did not sufficiently advert to the circumstance that what contained the water and

steam was made of wood, but what contained the fire and smoke was of iron. Two boilers were thus constructed for the two dredging engines: a wooden box of 4 inch fir planks bolted together like a wooden cistern, about 9 feet long, 6 feet wide, and 6 feet 6 inches high, with iron tubes running through it for the fire-place, flues, and chimney. The first wooden case had the flues renewed two or three times, and itself had a new top once; but the principal part of it lasted twenty years."

It will be perceived, that the digging engine was in some particulars superior to other machines afterwards introduced; and this fact is proved by the following note of expense found amongst Sir Samuel's papers:

"*Details of Expense of Digging Engine per day.*

	£	s.	d.
"Master per day............	0	5	0
"Engine man, ditto..........	0	5	0
"Boy	0	2	0
"Six labourers at 3s.........	0	18	0
"Interest of money laid out on the digging machine, and wear and tear of ditto	1	10	0
"12 bushels of coals at 1s. 6d. per bushel	0	18	0
"Total per day......	3	18	0

"Or less than 1*d*. per ton, as the engine dug out 2 tons per minute."

Mr. Goodrich, under other circumstances, states that it costs less than 2*d*. per ton to raise and deliver shingle from a depth of 27 feet, allowing a per centage of 50*l*. per annum for wear and tear; and to show what immense savings were, or might have been effected by the introduction of the dredging machine worked by steam, I shall conclude by the following extract from one of Sir Samuel Bentham's papers in the *United Service Journal** :—

"The profits upon the contract for digging mud off Woolwich Dock-yard, when the contractors were raising 700 tons per day, amounted to about 40*l*. per day, comparing the price paid to them with the expense at which it would have been raised, had Government raised it as at Portsmouth, on their own account, the engine employed by the contractors been similar to the one I contrived and brought first into use off Portsmouth Dock-yard."

I am, Sir, your's respectfully,
T. G. CHESNEL.

Hampstead, August 4, 1845.

* Year 1830, Part I. page 198. See also "Naval Papers," No. VIII., page 66.

GEOMETRICAL CONVERSION OF CONVEX SURFACES.

(Continued from page 100.)

PROBLEM III.—*Having given the diameters of the two parallel ends of a conic frustrum, and the perpendicular distance between them, to determine, by a geometrical construction, the diameter of a circle whose area shall be equal to the convex surface of the frustrum.*

The solution of this problem is rather more difficult than either of the preceding ones, yet it is sufficiently easy when the principles of construction have once been investigated. In order to this,

Put D = the diameter of the greater end of the frustrum.

d = the diameter of the lesser end.

s = the slant distance between the ends or length of the side.

And r = the radius of the equivalent circle.

Then, because the convex superficies of the frustrum is expressed by half the sum of the circumferences, drawn into the slant distance between them, we have, by comparing this with the area of the equivalent circle,

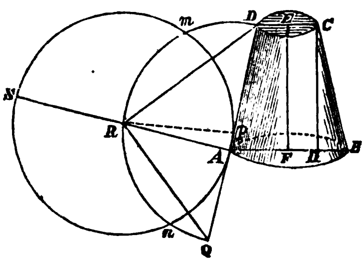
$$3{\cdot}1416r^2 = 3{\cdot}1416 \times \tfrac{1}{2}(D+d)s;$$

and this, by expunging the common factor 3·1416, becomes $r^2 = \frac{1}{2}(D+d)s$; that is, the radius of the equivalent circle is a mean proportional between the slant distance of the ends and half the sum of the two diameters; hence this construction.

Let A B C D, fig. 3, be the conic frustrum; A B, D C, the diameters of its ends, and E F the axis or perpendicular distance between them, A D being the slant height, or length of the side between the parallel ends of the frustrum. From the point C, the extremity of the lesser diameter D C, let fall the perpendicular C H, meeting the greater diameter A B in the point H; then is A H equal to A F + D E, the sum of the semi-diameters. Produce the side D A directly forward, until A Q becomes

equal to A H; then is D Q equal to D A + A F + D E, the sum of the slant

Fig. 3.



side and two semi-diameters. Bisect D Q in P, and on the point P as a centre, with the distance P D or P Q as radius, describe the semicircle D *m* R *n* Q; then, at the point A, in the line D Q, erect the perpendicular A S, intersecting the semicircle D R Q in the point R, so that A R shall be a mean proportional between the slant side A D and the sum of the semidiameters A F and D E. For, if from the points D and Q, the extremities of the diameter D Q, we draw the straight lines D R and Q R; then, by the nature of the figure, the right-angled triangles Q R A and R D A are similar, so that A Q : A R :: A R : A D; hence it is manifest that A R is a mean proportional between A D and A Q. But it has been proved that the radius of the circle whose area is equal to the convex surface of the frustrum, is also a mean proportional between A D and A Q; hence A R is equal to the radius of the equivalent circle. Upon the point R as a centre, with R A as radius, describe the circle A *m* S *n*; then shall the area of the circle thus described be equal to the convex superficies of the conic frustrum A B C D, contained between the parallel planes or ends whose diameters are A B and D C.

By developing the superficies of the three foregoing figures, an equivalent area could also be readily found, but in neither case would the construction be purely geometrical, and the results would be only approximative. Not so however with the constructions here given, for they depend on the principles of pure geometry, and the results, geometrically considered, are rigorously correct with regard to the principles employed in obtaining them; viz., the simple determination of a mean proportional between quantities whose absolute magnitudes are known.

What has been said above with respect to the development will be rendered manifest by what follows. If the convex superficies of a right cylinder, fig. 1, be developed on a plane, the development as we have already stated, will be a rectangular parallelogram, having one side equal to the length of the cylinder, and the other equal to the circumference of its base. Here, then, it becomes necessary to lay down a straight line equal in length to the circumference of a circle of which the diameter is given. Now, it is a well-known fact, that there is no method of doing this by principles which are purely geometrical, although there are methods of approximating to it, and which methods are more than correct for every practical purpose. Again, if the convex superficies of a cone, fig. 2, be developed on a plane, the development will be a sector of a circle whose radius is equal to the slant side of the cone, and the bounding curve equal to the circumference of its base. Here again the principles of pure geometry are at fault, for there is no method, purely geometrical, by which we can describe a portion of one circle that shall be exactly equal to the circumference of another, although the thing may be done approximatively to any practical degree of exactness required.

Lastly, if the convex superficies of the conic frustrum, fig. 3, be developed on a plane, the development will be a portion of a circular annulus, of which the breadth is equal to the length of the slant side of the conic frustrum, and the bounding curves equal to the circumferences of its ends, the radii of these bounding curves being respectively the slant side of the entire cone from which the frustrum is cut, and that of the cone cut off above the frustrum, so that the principle of construction in this case fails, for the same reason that we stated for the cone; for the developed area is manifestly nothing more than the difference between two circular sectors, whose radii differ from each other by the breadth of the development.

PROBLEM IV. *Having given the diameter of a sphere or globe, to find geo-*

metrically the diameter of a circle whose area shall be equal to the convex superficies.

This problem may be constructed on the same principle as the first in respect of the right cylinder, being only a particular case of the general construction there given, viz., that in which the length of the cylinder and the diameter of the base are equal to one another; for it is a well-known fact in geometry, that the surface of a sphere is equal to the convex surface of its circumscribing cylinder; hence the mode of construction is manifest; for we have only to describe a circle with a radius equal to the diameter of the sphere, and the circle thus described will be equal in area to the spheric surface, and it will contain an area equal to four great circles of the sphere, or four times the area of a plane that passes through its centre. A separate construction for this case is unnecessary, the principle being so obvious as to require no illustration by a diagram.

The surface of a sphere can be projected in several ways upon a plane, but it cannot be developed; this arises from the circumstance of its being a surface of double curvature, which does not admit of being expanded upon a plane; and what is said of the whole surface is equally true of any portion of it; but a circle can always be found that shall contain an area, equal to any portion of the spheric surface, by the method just described; for the superficies of any segment of a sphere cut off by a plane, parallel to the base of the circumscribing cylinder, is equal to the corresponding part of the convex superficies of that cylinder.

THE HISTORY AND RESUSCITATION OF THE CLAVIOLE, OR FINGER-KEYED VIOL. BY JOHN ISAAC HAWKINS, ESQ., C.E.

Sir,—The present communication was commenced immediately after the publication of your Number for December 17, 1842, but I was at the time so pressingly engaged, that when the paper was finished several weeks afterwards, I thought it too late to be sent in as an answer to Mr. Savage's remarks in that Number of your Journal. It has therefore lain on the shelf until now.

The republication, however, of the Report of a Committee of the Franklin Institute, in the last Number of your very useful Journal, has stimulated me to send the paper for your consideration and insertion in your pages, should that meet your approval, and I will now add some further remarks.

It is curious that the Franklin Institute should call attention to the Claviole at this particular time, since I have had several men at work for a few weeks past on the instrument in putting it in thorough repair, intending again to bring it before the public, and I expect in the course of the next month it will astonish and delight the philosophical and musical world as it did forty years ago, in Philadelphia and in London.

The communication of my worthy friend, Mr. Alfred Savage, at page 561, vol. 37, December 17th, 1842, of your valuable Magazine, has awakened in me the desire of giving to the public some account of the Claviole, which Mr. Savage in his last paragraph hints "has for ever gone to sleep."

The pressing avocations of superintending my everlasting pen manufactory, and in giving professional advice as consulting engineer and patent agent, will prevent my racking my brain much on the subject; but I have ransacked my papers and found documents enough to form an interesting history of that extraordinary instrument, copies of which I hand over to you, to be culled and inserted according to your judgment, as the whole might be tiresome to your unmusical readers, who, I have no doubt, bear but a small proportion to those who delight in the concord of sweet sounds; for it is well known that the lovers of science are almost always lovers of music.

After the history of the Claviole, I purpose giving an outline of some of the principal points of its construction, referring the reader to Rees's Cyclopædia, under the term "*finger-keyed viol*" for a more particular description, and an elaborate engraving by the celebrated Wilson Lowry, from a drawing made upwards of thirty years ago, by the accurate and indefatigable John Farey, who, no doubt will rejoice at an opportunity of hearing the instrument again.

I also send you herewith a drawing exhibiting the manner in which the horsehair is affixed to the bows, or rather rings, to produce the perfect effect of the violin bow, without the breaks occasioned by

its reciprocating motion, the revolution of the claviole bow producing a continuous tone, and in that respect the instrument is a perfect organ, of a much purer tone than any other organ, there being but one unison, and no discord-generating stops, such as the twelfth, tierce, cornet, &c.

I have not yet found any memoranda to determine the exact date of the first idea of the instrument, but I made the first bow before the year 1800, at Bordenton, in the State of New Jersey, United States. The invention therefore belongs to the last century and to the United States of America.

The earliest document I find, is a hand-bill of a concert which I gave in Philadelphia, on the 21st of June, 1802; the following is a copy:—

"*Grand Concert of Vocal and Instrumental Music.*

John I. Hawkins proposes having a Concert on the evening of the 21st instant, at the Hall of the University, in Fourth-street, when he will perform on the

Claviole,

a musical instrument entirely new; possessing powers superior to all others, and which has never before been exhibited.

Part the First.

Overture, Haydn.
Concerto on the Claviole, by John I. Hawkins.
Song,
Solo on the Violoncello by Mr. Schetkey.
Glee, 'Sigh no more Ladies.'
Medley of favourite Airs on the Claviole.

Part the Second.

Symphony, Mozart.
Song, 'A wish,' by J. I. Hawkins, accompanied by him on the Claviole.
Sonata on Hawkins's patent portable grand piano,* by Mr. Taylor.
Duet, 'Hark the Goddess Diana.'
Full piece, Band and Claviole, Gyrowez.

June, 18th, 1802."

The concert was given at the time appointed, and from the warm manner in which the audience expressed their unqualified approbation of the varied powers of the instrument, and the pressing requests that I would afford an opportunity for their friends to hear it, I issued the following hand-bill:—

"*The Claviole* having excited great curiosity, an many persons being desirous to see it, J. I. Ha kins has set apart every evening this week to ex bit its powers and construction, at Mr. Peale's Mu eum, between the hours of 8 and 10, and as it ca ot be expected he should devote his time gratis he will demand for admittance 25 cents.
iladelphia, June 23, 1802."

he Claviole was exhibited according to the hand-bill to crowds of visitors; but engagements in my profession precluded my continuing the exhibition. It was soon known, however, that I usually played on the instrument in the evening, and hundreds of persons assembled in the street opposite the house, on all the fine evenings of the month of July. Ladies of the first respectability had chairs and stools brought by their servants to sit in the street, opposite the windows, which of course I gallantly threw open, that the company might hear the better.

A long journey kept me some months out of Philadelphia, and when I returned I was too much occupied in preparing for a trip to Europe, to spare much time for the Claviole.

The following three letters were received from Mr. Joseph Leacock, a philosophical character residing in Philadelphia.

LETTER I.

"Philadelphia, August 4th, 1802.

"Sir,—Having a great desire (though far advanced in years) of seeing and hearing the new musical instrument of your invention, in America, ere your embarking with it for England, I intimated that longing desire to Mr. Raphael Peale, who said you had declined exhibiting it any longer in this country, notwithstanding which he hoped I might be gratified, and that he would endeavour to prevail on Mr. Hawkins to grant this favour to me and a few friends of genius, and lovers of good music, on some evening when most convenient to you; some who have heard it regret my omitting the availing myself of the gratification in due time. Notwithstanding the great desire I have to be indulged, I must waive the gratification rather than give unnecessary trouble to you, Sir.

"With good wishes for your success,

"I am, yours, &c.

"JOSEPH LEACOCK."

"P.S.—I have heard that when the Viol shall have been completed in London two are to be sent to America, one for the President, and one for Mr. Peale. This will be as it ought to be, and I hope for the credit of the country where the Viol originated, that the first two, when completed, may be forwarded regardless of all other considerations. What delight will not this music afford our good President, (Jefferson,) whose soul will be in unison with its harmony, and what an acquisition will it be to the Museum. It will, like the attraction of the needle to the pole, attract and draw all harmonious souls to that repository of the wondrous productions of the God of nature, the contem-

* This instrument was the grandfather of the pr ent Cabinet, Piccolo, and other pianos with sh t upright strings.

plation of which surpasses all that can be uttered by the tongues of men."

Letter II.

"Philadelphia, August 6th, 1802.

"Joseph Leacock's respects to Mr. Hawkins, thanks him for his indulgent kindness in exhibiting his lovely Claviole, and delighting him with its harmony. His calling at the residence of Mr. Peale on the 5th inst. was merely to learn when it might be most convenient for Mr. Hawkins to gratify not only himself, (as not being of a niggard or selfish disposition,) but a few friends of a congenial turn, having previously anticipated the favour to be granted.

"Should it not be deemed too troublesome and too presuming on good nature, he wishes to accompany his friends to that pleasing apartment at six o'clock on Saturday evening next, being the 7th of August, 1802, if convenient to the ingenious inventor of that first of all musical instruments, exceeding even the organ.

"Mr. Peale informs me you will leave the city this day. I imagine the Viol will be left where it is; in that case, (provided you have no objection,) I am persuaded Mr. Peale will have none to show it to a few friends."

Letter III.

"Philadelphia, February 14th, 1803.

"Mr. Peale,—Your well-wisher, Joseph Leacock, is strongly of opinion that nothing can possibly be more conducive to attract company to your Museum than one of the Claviole invented by the ingenious Mr. Hawkins; such music as that is irresistible, and cannot fail drawing harmonious souls there.

"I felt the force of it powerfully, although the instrument was not in good order; you expect to receive one from London, but it will be too long coming.

"I wish to see one set about immediately, ere that gentleman's departure. I have been told he intends having another completed ere his departure.

"Cannot you set your ingenious workman, now fixed snugly under your immediate eye in the Steeple, (and a good warm place it is,) to imitate progressively every part of the wood-work? By observing the operator occasionally he can undoubtedly imitate it exactly.

"Do but get one of these rapturous Claviole, and a chandelier for lighting the apartment, and, without doubt, many will make that place their evening resort. I have no objection to your showing this to Mr. Hawkins, being persuaded his sentiments will be in unison with mine, for the gratification of the public and the promotion of your merited interests.

"Let us have the Claviole, say I; such music will charm and draw me every night to that pleasing retreat, and although my visit may not afford pecuniary benefit, it matters not, I know your generosity thinks little of that.

"The Museum is brilliant at present, but when the Claviole is in operation you will have leisure time to embellish it as much as you please, and the more so the better, till it vies with and even eclipses that of London."

I left Philadelphia in June, 1803, after having dismantled the Claviole, and packed it up to remain safely till my return. I arrived in London in August 1803, where, under my patent, dated Nov. 13, 1800, I commenced the manufacture of the Claviole, in the year 1805, and finished one, to which I called the public attention, in September, 1806.

Some of the opinions of the musical world were recorded in a prospectus which I drew up six years afterwards, which is as follows:—

"Proposals for building, by subscription, a superlatively grand musical instrument, to be called *The Millechord Claviole*, or thousand-stringed finger-keyed viol; to be constructed with one thousand gut strings, the tones produced by rosined horsehair bows, and artificial fingers, acted on by four sets of finger-keys and eighty pedals, together with barrels of large dimensions, which, with the bows, will be turned by machinery, giving the full power and variety of a band of two hundred performers.

"The instrument will yield the perfect sounds of the violin, viola, violoncello, double bass, harp, and organ; will closely imitate the flute, clarionet, oboe, bassoon, fife, flageolet, union pipes, horn, trumpet, bugle-horn, musical glasses, celestina, eolian harp, &c., as well as produce sounds entirely new and peculiarly delightful; and will scarcely ever be out of tune.

"The expense of the Millechord Claviole, tastefully ornamented, and designed for constant exhibition, is estimated at 4,200*l*. It is therefore proposed,

"1st. To raise the sum of five thousand pounds, in 100 shares of 50*l*. each, payable by instalments.

"2nd. As soon as the whole number of shares are subscribed for, a meeting of the subscribers shall be called, for the purpose of choosing a Treasurer, to receive the instalments; and a committee to manage all the money concerns, to order the commencement of the work, to inspect its progress,

and to make such regulations as they may judge necessary.

"3rd. John Isaac Hawkins, the inventor, to direct the construction of the instrument, at a reasonable salary, to be fixed by the committee, and to have ten shares in the concern, clear of all payments, as a remuneration for his patent right; he shall employ the best workmen, purchase the best materials, and present regular accounts to the committee, without whose consent no expense shall be incurred.

"4th. The instrument, if commenced immediately, may be ready for exhibition early next spring. It shall be the joint property of the shareholders, and exhibited in London, from about December to June, and at different provincial towns, from about June to December; the profits to be divided quarterly among the shareholders.

"5th. The Millechord Claviole will be such a universal attraction, and the current expenses so small, that no person acquainted with the nature of exhibitions, would estimate the average profits at less than 10*l.* a-day, 3,000*l.* a year, or 54 per cent. interest on the capital advanced: consequently the 50*l.* shares will probably be worth 700*l.* each, soon after the instrument is finished.

"*Observations and Testimonials.*

"The Claviole is no unrealized project. The inventor made one in Philadelphia ten years ago, with sixty-six gut-strings and one set of finger-keys, which was pronounced by several professors to be equal in power to fifteen performers in a band; and possessing at the same time all the delicacy of tone requisite to accompany a lady's voice. Many summer evenings when this instrument was giving forth its astonishing tones, in a private room, have hundreds assembled in the street, to have their ears regaled with its enchanting harmony; numbers of the most respectable inhabitants frequently sent their servants with chairs and stools, and seated themselves in the street to enjoy the ravishing sounds.

"Six years since, a second Claviole was constructed in London, with the same number of strings, concerning which, the following language was used by amateurs, professors, &c., who came to hear it.

"The words were written down at the time, and they form but a very small part of the encomiums which were lavished on the instrument, during the eight months it was before the public.

"*October 3rd,* 1806, *Mr. Hawkes, an Amateur and Writer on Music.*

"It is certainly the best instrument in existence. I could not believe it possible to produce such effects."

7th. Dr. Tilloch, Editor of the Philosophical Magazine.

"It is superior to all other instruments."

*11th. Mr. Hawkes, a third time, with Mr. Purkis, an eminent Professor.**

"The professor said he was in a hurry, and could stay but ten minutes; he soon felt the powers of the instrument, and produced effects which astonished the inventor as well as himself, and Mr. Hawkes, who had heard it twice before. N.B.—They stayed three hours!!!

12th. Mr. Evans, Professor.

"I think it the grandest instrument by far of any ever made; you cannot fail making an immense fortune by it."

16th. Messrs. Button and Purday, Music-sellers.

"We shall be glad to have the first you sell to the trade; we were led to expect something great, but had no idea of seeing anything like this."

28th. Mr. Purkis, third time, and Friends.

"It is an astonishing instrument; what a swell in every note! here is the violoncello exactly, and here the violin, here the clarionet, the oboe, and the flute!"

Mr. Hawkes, 7th time, and friends.

"Do you not think it is a most grand thing?"

"It is a most extraordinary instrument indeed."

31st. Mr. Dobbs, an amateur, and friends.

"It is a sweet instrument—there is the violin—there the violoncello exactly—a full band—the organ."

Nov. 7th. Dr. Kitchener, the well-known writer, on music, optics, and cookery, accompanied by a friend.

"It far surpasses my expectation; it is a most delightful instrument."

10th. Mr. Barthelemon, an eminent composer, and first violinist of his day.

"It is superior to the organ." N.B. Mr. Barthelemon was in a hurry—"cannot stay above one minute;" but actually continued playing on it for three hours!!!

Dec. 11th. Dr. Kitchener, a second time.

"Now you shall hear the finest instrument ever made. Did not I tell you you would be highly gratified—you are not sorry you broke your appointment. This instrument wants nothing but publicity; how much like Walker's Celestina, but infinitely superior!"

Mr. Cubit, Professor.

"Indeed, it is the most perfect instrument in the world. Oh! it is charming!—it is just what was wanted. They will be in immense demand immediately. The proprietor of this patent will, in a very short time, be able to bid for the loan."

Dec. 18th. Mr. Tulk,† an amateur, and friends.

"Oh, most delightful! It is far superior to any-

* Mr. Purkis is the eminent Professor of Music, who, for near thirty years, performed on the Apollonicon in St. Martin's-lane, and who was born blind, and received his sight at thirty years of age, by the skill of the late Sir W. Adams. Mr. Purkis produced more extraordinary effects on the Claviole, than any other performer, and astonished even the late eminent organist, Charles Wesley, whose performance on the Claviole was far inferior to Mr. Purkis's. One reason appeared to be that Mr. Purkis, having very long fingers, was able to stretch a twelfth, and thus play ten notes at once, while Mr. Wesley, whose fingers were very short, could scarcely stretch an octave, and generally played but five or six notes at a time.

† Afterwards a member of Parliament.

thing ever before seen; it is capable of every species of music."

1807, *Feb. 10th. Mr. Mugnie, an eminent composer and performer.*

"I have travelled through Germany, Italy, France, Spain, &c., and have seen many fine musical instruments, but never anything to be compared to this. It is the finest instrument in Europe—in the world. It will make you a large fortune."

14th. Mr. Mugnie, second time.

"There is no such instrument in Europe."

20th. Mr. Mugnie, third time, and friends.

They all declared themselves delighted beyond expectation; Mr. Mugnie could hardly leave off playing.

April 9th. Mr. Purkis, fourth time, and friends.

"I have been several times, and every time I discover new beauties—it is sublime. I could sit at it for five or six hours. It has the effect of a full band."

If such was the effect produced from sixty-six strings, what is not to be expected from a thousand, acted on by machinery of exquisite workmanship, and accompanied by four first-rate performers on the finger-keys and pedals!

A third Claviole with sixty-eight strings has been finished about two years, which, with the former continues to give the highest satisfaction to their respective owners.

A fourth will be completed in about a month, with the same number of strings.

From the immense variety of experiments made on this subject, at an expense of some thousands of pounds, during a period of seventeen years, the inventor is enabled to pledge himself, that the projected instrument shall remain in tune for years, that it may be taken to pieces, carried hundreds of miles by land or water, and erected again in a few hours, without being put out of tune.

JOHN ISAAC HAWKINS.

79, Great Titchfield-street, London,
June 22, 1812.

At the period of issuing the above prospectus, and for many years after, I was closely occupied on several engineering works, I therefore had no time to push the prospectus, and so nothing was done in it.

But, pressed by my friends, and having two or three weeks leisure in the autumn of 1813, I took the Claviole to Brighton, where I exhibited it in an *auction* room, utterly unconscious of this being the means of drawing down aristocratic neglect and contempt.

Seeing, however, that public notice was not aroused by mere advertisement, I wrote the following saucy letter, No. I, had it published in two or three newspapers, and caused a thousand copies of it to be printed and laid on the breakfast tables of the principal boarding, and other houses; this acted like an electric shock, and brought crowds to the auction room, who were enthusiastic in their plaudits, and many expressed great regret that their friends, who had left Brighton, had lost the opportunity of hearing the instrument.

The strong sensation thus created induced the proprietor of the Marine Library to offer the use of one of his rooms gratuitously, which I accepted, in deference to the requirements of the aristocratic feeling which abhorred the poor auction room; and the company then remaining in Brighton continued to visit it in great numbers, and to express their satisfaction at having the instrument brought before their notice. I announced the removal of the Claviole to the Marine Library, by letter No. II, and afterwards published a valedictory letter of thanks, No. III. Extracts from both these letters follow the reprint of the whole of No. I.

LETTER No. I.

"*To the Company at present at Brighton.*

"Ladies and Gentlemen,

"Having come to Brighton for a short time to inhale the refreshing breezes from the sea, and being incapable of lounging about all the day without some pursuit, I brought with me for the purpose of exhibiting, as a rare production of art, a musical instrument called the CLAVIOLE; consisting of 68 gut-strings, acted on by rosined horsehair bows, and played with finger keys, like the organ; which instrument has cost me, in experiments, little, if anything, less than 5000*l.*, during twelve of the best years of my life; but not having succeeded in exciting the public curiosity, I beg leave to announce that the exhibition will close on Thursday next, Oct. the 7th, and unless the ensuing five days are more productive than the preceding, the instrument will be for ever withdrawn from public view; if, on the contrary, there is any encouragement, it will be afterwards shown three days at Worthing.

"Feeling somewhat sore, at seeing one of the eldest children of my brain treated with such chilling indifference, notwithstanding the very high encomiums that have heretofore been lavished on it, by the first philosophical as well as musical characters in the country, I cannot help dilating a little on the causes, and I must be excused if my language assume somewhat of the tone of remonstrance.

"The principal cause seems to be, the style in which this instrument is offered to

public notice. It is inclosed in a plain mahogany case, and exhibited in an auction room, and therefore the merits of its construction go for nothing.

"The Claviole is shown for the peculiarity of its mechanism, and not for any exterior embellishments; in truth I have no great taste for decorations, and do not see the necessity of them in this case; more particularly, since permanently exhibiting the instrument forms no part of my plan, my showing it now is a mere whim of the moment.

"Every upholsterer will display before you, gratis, curtains elegantly fringed and festooned, and cabinets curiously inlaid and gilt; but it is at the Auction Mart, St. James's Street, Brighton, and there only, that a Claviole can at present be seen; it must, however, be seen in its own plain garb or not at all. Would two pennyworth of gold, beat as thin as a cobweb, and stuck upon the instrument, add, in the least degree, to the harmony of the music; or a few yards of fringed silk, enable you the better to comprehend the mechanism? Shall no work, however ingenious, succeed, except it appear in a fine dress? Must everything assume the same livery? Is the taste of the upholsterer so paramount to every other consideration, that, like the unfortunate victims of the bed of Procrustes, every work of art must be brought to its measure? Forbid it variety! forbid it taste! forbid it common sense!

"Nature has none of this intolerable monotony; she gives everything its variety of external appearance as well as of internal quality.

"If the Claviole has not attractions enough in its mechanism and tones, I never will descend to the pitiful shift, of catching the eye by gaudy trappings; I really am too proud to adopt such meretricious means.

"Another most powerful cause of the neglect of the Claviole possibly is, *it is home-made!* It is not announced as the invention of a foreigner with a name a yard long, and so cramp, that an Englishman, with a tolerable flexibility of the organs of speech, might labour in vain for a week to pronounce it. It was not brought from Vienna, nor Paris, nor Rome, but, Oh, vulgar to relate! was made in London!

Another reason may be, the Claviole affords some food for the mind; it is a mechanical, and consequently, an intellectual study. Now it does not appear that the general intention of a jaunt to Brighton is to pursue intellectual inquiries! the most attractive amusements seem to be those that require the least thinking, and indeed I knew too much of human nature before I came here, to suppose things would be otherwise; I never expected to attract the great bulk of the *beau monde;* but I did hope to call together the scientific characters of the place, and enjoy the high gratification of a mutual interchange of knowledge; instead of which I have been imprisoned in the Auction Mart, four hours every day for nine days, without meeting a dozen persons that I could draw into rational conversation.

"Other causes of my want of success in exhibiting the Claviole, might be mentioned, but I will not, however, intrude upon your time by enumerating them.

"But some of you will say, 'Perhaps this fellow is only a quack, and his instrument not worth seeing; if I pay my shilling I shall most likely wish it in my purse again.' Very well, my friends, suppose for a moment this to be the case; here is a plan for ascertaining the fact at a small expense: Let a party of twenty-four persons subscribe each a halfpenny, to pay the price of admission for one of the most intelligent among them, and appoint him envoy extraordinary to examine the Claviole, and report how far the instrument is worthy their notice. I would offer free admission to the representatives of parties, did I not apprehend trouble from too many *soi-disant* ambassadors.

"While sitting at the Claviole, waiting for company, and being never lonely when alone, I amused myself, by sketching in my mind, a systematic view of the nature of happiness; being pleased with the subject, and wanting occupation, but not feeling in a humour to return into the carburetted atmosphere of London for some days yet, I purpose delivering at the Castle Inn, Brighton, on Friday next, October 8th, A PHILOSOPHICAL LECTURE ON HAPPINESS, and the means of obtaining that universally pursued object.

"The Lecture to commence precisely at twelve o'clock.

"N.B.—I do not use the word *precisely* with the latitude commonly attached to it.

"Admission one shilling.

"I fix that low price, because, this being my first attempt at lecturing, I don't know but I may make a bungling hand of it, and if I should, we may console ourselves that the experiment has been tried at a small expense: by the bye, I wish I could say so of the Claviole experiment, and fifty others I have formerly made at great cost.

"I flatter myself, however, that you will at any rate receive as much value for your shilling as you generally obtain at *some other places;* I shall endeavour to amuse, and if you will allow the expression, instruct you. Should I succeed, and you wish a repetition

of the lecture, it will be an easy matter, you know, to raise the admission to a more respectable price.

"I am, Ladies and Gentlemen,
"Most respectfully,
"Your very obedient humble servant,
"JOHN ISAAC HAWKINS.

"Brighton, Oct. 1, 1813."

EXTRACT FROM LETTER No. II.

"Ladies and Gentlemen,

"Mr. Walker, having very handsomely offered the use of a room at the Marine Library, gratis, for the purpose of exhibiting the Claviole, I am induced to let it remain one week longer before the public.

"The instrument will be shown for one shilling each person, between the hours of twelve and four, every day this week, after which time I shall take it to London, and never more exhibit it. This experiment of bringing the Claviole out for a show has so completely sickened me, that I am quite sure I shall not make a second attempt.

"There is another experiment which I have been trying almost all my lifetime without success, and that is, to gain money by mechanical and other useful inventions; but I do not attribute this failure to any fault of mine; I lay the blame wholly on the public: I do seriously consider the public, and many individuals, as immensely in my debt on this score. Fortunes have been made; fortunes are now making; and numerous fortunes will hereafter be made by my inventions, while I only am the loser!

"The public receive my productions when offered singly by other hands, but they refuse taking them from me, because they fancy I shall make further improvements. 'I'll wait till you have made a few more of them, and then I'll have one; I know you will make improvements yet,' has been the selfish and ungracious answer I have a hundred times received, when soliciting orders for a new invention. Thus, none being willing to buy the first specimen, I have, in disgust, declined the manufacturing of many very useful machines after spending large sums of money on them.

"Another alleged motive has been, that since I manufactured a variety of articles, it was not likely I could make them as perfect as those who confine their attention to one. Thus, without taking the trouble to enquire into the specific merits of the case, they decided against my pretensions upon abstract principles.

"Here I acknowledge myself defeated by public prejudice, and decline any further contest; but, conscious that I have made a noble stand, and deserved better fortune, I demand permission 'to march out with all the honours of war, colours flying,' &c.

Signed, "JOHN ISAAC HAWKINS.

"October 8, 1813."

EXTRACT FROM LETTER No. III.

"Ladies and Gentlemen,

"I should not do justice to my feelings, were I to leave Brighton without tendering my sincere acknowledgments to the public, for the very flattering notice the Claviole has obtained, since Mr. Walker's kindness permitted the instrument to be exhibited at the Marine Library; and I cannot resist the numerous solicitations of beauty, rank, and intelligence, that the Claviole might remain open a few days longer, in order to give those ladies and gentlemen who have seen and admired it, an opportunity of increasing their pleasure, by inducing their friends to partake of the gratification which they enjoyed in viewing the singular mechanism, and listening to the delightful tones of that unique production.

"The exhibition of the Claviole will therefore be continued at the Marine Library, between the hours of eleven and four, every day until Saturday the 23rd instant, on which day it must be closed at two o'clock, and be packed that afternoon before dark.

"In reply to the many strong expressions of regret which have been elicited, in consequence of my declining to manufacture Clavioles for sale, I beg leave distinctly to state, that I have no objection to commence making them, whenever twenty, at least, shall be ordered, agreeably with the following terms; but standing, as I do, 5,000*l.* minus by the invention, I have determined not to proceed any further with it on speculation.

"*The Terms.*

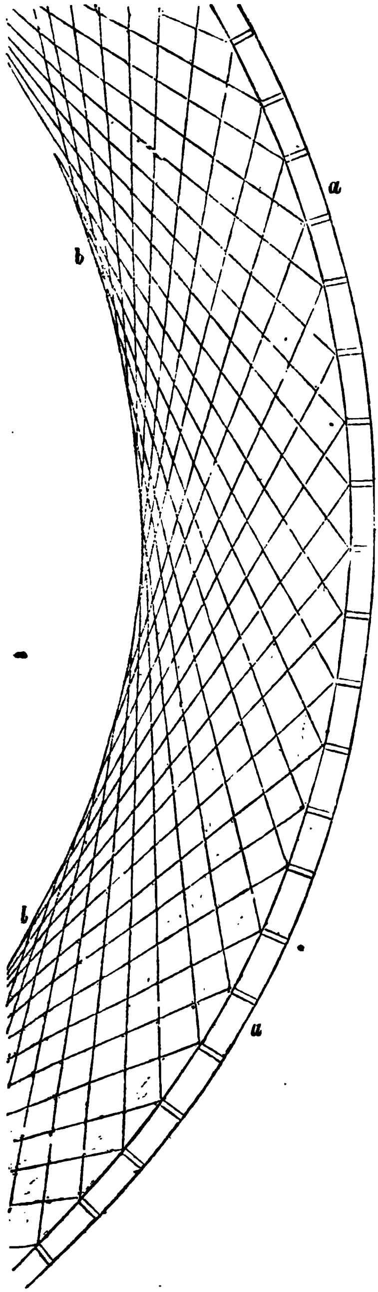
"1. A Claviole with one string to each finger-key, similar to that now exhibited, the case to be ornamented in the most fashionable style. Price 200 guineas.

"2. A Claviole with one string to each finger-key, the double bass acted on by pedals, and the bows turned by a machine, which a servant may occasionally wind up, case ornamented as before, 250 guineas.

"3. A Claviole with two strings to each finger-key, the double bsss with pedals, the bows turned with machinery, and case ornamented, 300 guineas.

"4. The whole number of instruments to be finished six months after the subscription is filled, and the subscribers to have the privilege of choosing, according to the priority of subscribing, provided they apply personally, or by an agent, within three days after

notice is left at their respective places of residence, or appointment, in London.



"5. The price to be paid for each instrument, on delivery.

"Immediately on my return to London, a subscription book shall be opened at my Essence of Coffee Manufactory, No. 79, Great Titchfield-street, Mary-le-bone.

"In issuing these proposals, I must frankly declare that I am not anxious to have the subscriptions filled, because I am well aware, that if the same degree of industry and care, necessary for that undertaking, should be exerted in my other avocations, a much greater pecuniary reward would attend it. Nevertheless, if the orders are received, the execution shall do me credit, and give satisfaction to every one who has not unreasonable expectations.

"Signed, JOHN ISAAC HAWKINS.
"October 19, 1813."

On my return to London, I was pressed by numbers, to allow them and their friends to see and hear the instrument; but as I could not, in justice to myself, devote time and trouble for public gratification, without remuneration, I issued the following posting-bill, and the instrument was exhibited till the end of August, 1814, since which time it has not been seen, except by my particular friends.

"In compliance with the pressing requests of many of the nobility and gentry, J. I. Hawkins will exhibit every Monday, Tuesday, Wednesday, and Thursday, until the end of August, 1814, between the hours of twelve and three, at No. 79, Great Titchfield-street, Mary-le-bone, London, that extraordinary musical instrument, called the Claviole, or finger-keyed viol, producing the rich and peculiar tones of the violin, viola, violoncello, and double bass, combining close imitations of the flute, flageolet, and musical glasses, with the full power and grandeur of the organ, forming in itself a complete band of music, played on by one performer. The only instrument of the kind in the world open for public inspection. Admittance one shilling."

In the year 1827 I went abroad, where I stayed some years; previous to my departure, I took all the strings off the instrument to prevent their breaking in my absence.

Since my return to England I have postponed, from time to time, the restringing of the Claviole, with the intention of adding two important improvements:—

First, the means of tightening the horsehair when rendered slack by frequent pressure on the strings, which slackening became so considerable after a few years' use, that much of the staccato

effect and much of the power of the instrument were lost. The delightful swell by the touch was also considerably impaired. The violinist knows well the value of a tight bow to produce staccato effect, swell, and power.

Secondly, I purpose placing, by means of pedals, eighteen of the bass notes under the power of the feet, as well as of the fingers, and thus, sounds will be produced from the thick double bass strings much louder than could possibly be drawn out by the strength of the poor little finger of the left hand; much louder, too, than the double bass instrument itself yields, because its tones are broken at every return of the bow, while the tones of the Claviole are continuous.

From these two circumstances it may reasonably be expected that the instrument will have its power doubled, and will therefore be equal to thirty instruments in a band, it having been estimated at fifteen formerly.

The fundamental and essential part of the Claviole is the ring-bow, consisting in fact of ninety-five little violin bows intersecting each other, forming a regular polygon of ninety-five sides, which is in effect a cylindrical surface of elastic horsehair, the passage of the angle over the string not being in the least degree perceptible. An engraved segment of the Claviole-bow is given in the preceding page; *a* is the ring; *b* the horsehair stretched in equal arcs of the circle, and intersecting each other.

The ring-bow is supported on three wheels in a horizontal position, and the strings are stretched vertically between two of the wheels, as close as possible to the horse hair, without touching it.

The finger-keys act, through the medium of levers and cranks, on the strings, to pull them against the revolving horsehair, and the tone produced is soft or loud in proportion to the depth to which the finger-keys are pressed down; thus a delightful swell is produced by the touch alone, the effect of which is much superior to any other mode of obtaining a swell, since each individual note is swelled independent of the rest.

There are four such ring-bows in the Claviole, one for the double-bass, having sixteen strings belonging to it; a second ring-bow for the bass, having eighteen strings; a third for the tenor, having seventeen strings; and a fourth for the treble, having seventeen strings.

The double-bass bow revolves slowly and has a great quantity of hair; the bass-bow turns quicker and has less hair, the tenor-bow still quicker, with still less hair, and the treble-bow moves very quickly and has but a small quantity of hair. And thus the respective speeds of the bows and quantities of hair approximate, in some degree, to the number of the vibrations of the strings, so as to produce power in the bass, and clearness and sweetness in the middle and upper notes.

The effect of the atmosphere to put the instrument out of tune by relaxing, and contracting the gut-strings, is counteracted by a long spiral spring attached to each string, which spring moves through a considerable space without sensibly varying in strength; the strings are therefore kept at a uniform tension, practically speaking, and the instrument keeps in tune for years, and, when strung with the best Roman strings, the breakage of a string rarely occurs.

It is a curious fact that numbers of pianoforte makers, organ-builders and others, have, since my patent expired in the year 1814, attempted to make sustaining stringed instruments with the view of producing the effects of the Claviole at a cheaper rate; but they have erred in endeavouring to find a substitute for the ring-bow, which is the essence of the invention, and which, with the machinery necessary to turn it and to bring the strings in contact with the horsehair, is necessarily very expensive, because requiring great excellence of workmanship to make the bows revolve in silence.

I think the finding of such a substitute, however, as will give the perfect violin tones, a hopeless case, and therefore the Claviole never can be a low-priced instrument; probably 200 guineas is the least sum it can be sold at, to afford reasonable profits to the maker and vendor. Nevertheless I am decidedly of opinion that, when I shall have departed this life, the Claviole will become the sovereign of musical instruments, superseding even the organ itself; the swell by touch, affording a power of expression in the Claviole, to which the organ makes no approach.

As I was £5000 out of pocket by the invention thirty-eight years ago, which

sum, at compound interest, would at the present time exceed £20,000, I may fairly consider the Claviole as now owing me this latter sum.

But as I do not intend making any more of the instruments, yet wish to recover a small portion of my great expenditure, I contemplate travelling with the Claviole through Europe and America, exhibiting it to the public at concerts, and giving lessons on its construction to musical instrument makers and others who may wish to manufacture them, and are willing to pay me for the results of my long experience. Thus I may realize, in advance, some portion of the posthumous profits which will be made by multitudes of manufacturers of the next generation, and be the means of saving them immense sums, which would otherwise be spent in experiments, were they to go to work without my instructions.

I am, Sir, yours truly,
JOHN ISAAC HAWKINS.

26, Judd-place, New-road.
Aug. 15th, 1845.

EMPLOYMENT OF THE ELECTRIC LIGHT IN COAL MINES.

Sir,—Permit me to suggest the propriety of employing the *electric light* in coal mines, as a substitute for the ineffective glimmer of the safety-lamp.

This light requires no support from the atmosphere. It can be completely isolated by means of glass globes. And it can be let off or on, almost at a wish, without having recourse to any combustible body for the purpose.

The electric light is simple, cheap, effective, and may be placed wholly beyond the control of the ignorant careless miner.

The means of realizing this light are well known, and need no enunciation here. They are as practicable in coal mines as elsewhere. Lights could be multiplied at pleasure in the galleries of the mines, and the light reflected where desired, by means of metal or glass specula, on any given distant point of working.

It strikes me that the introduction of the electric light into coal mines, is abundantly practicable; and if practicable, infinitely desirable, as tending to prevent those disastrous explosions and consequent loss of life, which science hitherto has been unable to avert.

I am Sir, your obedient servant,
W. CORMAC, M.D.

Belfast, July 16th, 1845.

MR. MILLAR OF DALSWINTON'S EXPERIMENTS IN NAVAL ARCHITECTURE.

Sir,—The perusal of the very just remarks in a recent Number of your Journal on the subject of the claims of William Symington, to be the first practical introducer of steam navigation into this country, and of the attempt made by some of the descendants of the late Mr. Millar of Dalswinton, to transfer the honour to that gentleman, (he does not appear to have ever himself advanced any pretensions of the sort,) has recalled to my recollection a passage in "Macpherson's Annals of Commerce," touching Mr. Millar's experiments in naval architecture, which you may, perhaps, think it worth while to re-publish. It may serve to show, that, however public-spirited and enterprizing Mr. Millar may have been, he was but a poor mechanician, and by no means the sort of man likely to have solved so difficult a practical problem as that of applying steam power to navigation. I send you also the article in the *Gentleman's Magazine* referred to by Macpherson, with a tracing of the engraving.

I am, Sir, your constant reader,
P.

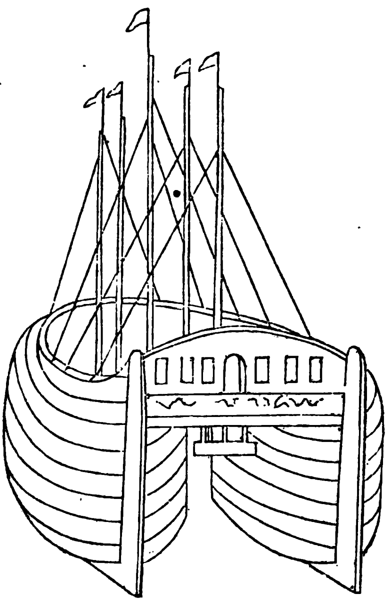
Birmingham, May 2, 1845.

Extract from Macpherson's Annals of Commerce, vol. iv. p. 178.

"About this time a number of new experiments were made upon the materials and the construction of vessels, both for inland and ocean navigation. In the preceding year Mr. Wilkinson, the proprietor of a very extensive iron work, constructed a barge, for the Birmingham canal navigation, of 70 feet long and 6 feet 8½ inches wide, of iron plates, which could swim in 8 or 9 inches of water, and carry thirty-two tons of goods, and this year a similar barge was constructed at Shrewsbury. A vessel with a bottom entirely of copper, without any plank, was built last year, and another of the same metal in the year 1789. At Leith a vessel was built with two bottoms, or rather two very narrow vessels were joined together by the beams of the lower and upper decks. She had five masts and was furnished with five wheels, under the lower deck and between the two bottoms, which were intended to

make way in a calm, or against the wind; and it was expected, that the double hold she had of the water would enable her to carry an extraordinary quantity of canvass with very little heeling. But in a passage which she made to Petersburg, the two bottoms were found to act as levers against each other, not merely in keeping her stiff (or upright) but also in straining the whole frame, whereby, she was so much injured, that nobody cared to venture home in her, and she was left in Russia. * * A slight sketch of this double ship may be seen in the *Gentleman's Magazine*, 1788, p. 1069."

Extract from the "Gentleman's Magazine," for December, 1788.

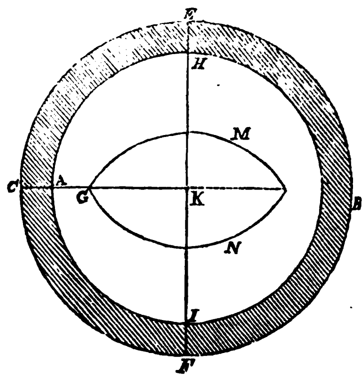


"This is a sketch of a vessel of a new construction invented by Patrick Millar, of Dalswinton, Esq. This vessel is a kind of double ship strongly connected by her upper works; she is 90 feet long, with her other dimensions in proportion, has five masts and is provided with wheels, which work a number of oars, to be used when there is no wind. She is said to have cost upwards of 3,000*l*. Whatever may be the success, Mr. Millar is entitled to the thanks of the public for risking so considerable a sum in the improvement of the naval architecture of this kingdom. This sketch was taken when she was lying on the mud in Leith harbour."—*Gent. Mag. December*, 1788.

CENTROBARIC MENSURATION. NO. X.

If the solidity of the globe or sphere, whose radius is K A, fig. 19, be subtracted from that whose radius is K C, the remainder will obviously be equal to the solidity of a spherical shell, of which the thickness is A C, and section through the centre, the shaded annulus B E C F.

Fig. 19.



But the solidity of the globe whose radius is K C = R, is $\frac{4}{3}\pi r^3$; and in like manner, the solidity of that whose radius is K A = r, is $\frac{4}{3}\pi r^3$; therefore by subtraction, we have $\frac{4}{3}\pi (R^3 - r^3)$, for the solidity of the spherical shell. This is the expression for the solidity of a spherical shell as it would be deduced by the common rules of mensuration, and we have now to show how the same expression is deduced from the properties of Gualdinus, or according to our principle of Centrobaric Mensuration.

Let the semi-annulus E C F I A H revolve about the straight line E F, which remains fixed in its plane; and by our general principle, it will generate a solid, the contents of which are equal to a prism, whose base is equal to the revolving area, and altitude the circumference of the circle described by its centre of gravity. Now, the area of the revolving semi-annulus is expressed by $\frac{1}{2}\pi (R^2 - r^2)$ and by mechanics, the distance K G is expressed by the term $\frac{4 (R^3 - r^3)}{3\pi (R^2 - r^2)}$ where G is the centre of gravity of the revolving area, and consequently K G is the radius of the circle described by that point during the revolution, the circumference

being $GMN = \frac{8(R^3 - r^3)}{3(R^2 - r^2)}$ which is equal to the altitude or height of the prism, whose solidity is the same as that of the spherical shell; but the base of this prism, which is equal to the generating area, is $\frac{1}{2}\pi(R^2 - r^2)$; consequently by multiplication, we get

$$\frac{8(R^3 - r^3)}{3(R^2 - r^2)} \times \frac{\pi(R^2 - r^2)}{2} = \tfrac{4}{3}\pi(R^3 - r^3),$$

being precisely the same expression as we obtained by taking the difference between the solidities of two spheres whose radii are R and r. But $\pi = 3{\cdot}1416$; therefore by substitution, we get the following numerical value, viz.—solidity of the shell $= 4{\cdot}1888(R^3 - r^3)$.

If the exterior and interior diameters of the shell be substituted instead of the radii, the expression becomes

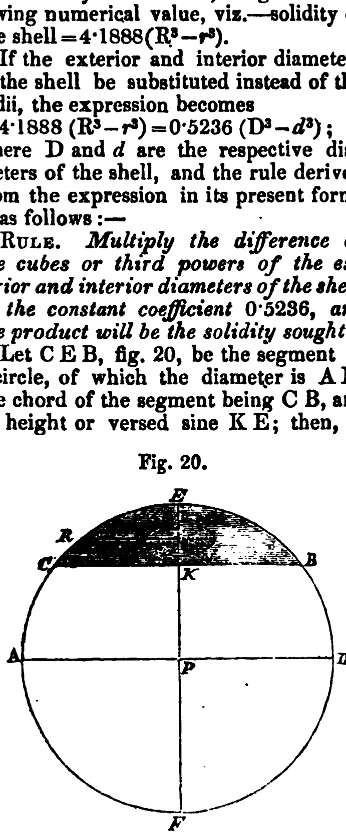
$4{\cdot}1888(R^3 - r^3) = 0{\cdot}5236(D^3 - d^3)$;

where D and d are the respective diameters of the shell, and the rule derived from the expression in its present form, is as follows:—

RULE. *Multiply the difference of the cubes or third powers of the exterior and interior diameters of the shell, by the constant coefficient* 0·5236, *and the product will be the solidity sought.*

Let C E B, fig. 20, be the segment of a circle, of which the diameter is A D, the chord of the segment being C B, and its height or versed sine K E; then, if

Fig. 20.



the semi-segmental plane K E C be made to revolve about the versed sine K E, it will by its revolution generate the segment of a sphere, whose section in direction of the axis is C E B, and solidity equal to that of a prism, the area of whose base is equal to the revolving plane, and of which the altitude is equal to the circumference of the circle described by the centre of gravity.

Since the semi-segments K E C and K E B, are equal and symmetrically placed with respect to the height or versed sine K E, or diameter E F, it follows, that the centre of gravity of the whole segment C E B, must be equally distant from C B, the chord or diameter of the segment's base, as are the individual centres of the constituent semi-segments, K E C and K E B. Now, by the principles of mehanics, the centre of gravity of the circular segment C E B, is distant from the centre at P, by a quantity of which the value is $\frac{c^3}{12a}$, where c is the chord of the segment and a its area. Therefore, to find the centre of the circle described by the centre of gravity of the revolving plane K E C, we must set off from the centre P, on the diameter F E, the distance P Q equal to the expression $\frac{c^3}{12a}$ obtained by calculation according to the dimensions of the segment; then will Q be the centre of the circle sought. Through the point Q, and parallel to the chord K C, draw the straight line Q R; the centre of gravity of the revolving plane, K E C, is situated in Q R, and distant from Q by a quantity whose value is $\frac{v(3c^2 + 4v^2)}{24a}$; where a and c denote as above, and v is the height, or versed sine K E. Upon the straight line Q R, set off Q G equal to the expression just obtained, and G will be the place of the centre of gravity of the generating area or semi-segment K E C, and consequently, the circumference of the circle described by the point G, is

$$GMN = \frac{\pi v(3^2 + 4v^2)}{12a};$$

but the area of the revolving plane is $\frac{a}{2}$,

and the solidity of the spheric segment generated by its revolution is therefore as follows, viz.

$$\frac{\pi v(3c^2 + 4v^2)}{12a} \times \frac{a}{2} = \frac{\pi v(3c^2 + 4v^2)}{24};$$

but the symbol c denotes the whole chord or diameter of the segment's base C B, whereas it is convenient to have it

in terms of the semi-chord or radius K C; for this purpose put $c=2r$, and then by substitution and restoring the value of π, we shall obtain the following expression for the solidity of the spheric segment, viz.

$$\text{solidity}=0{\cdot}5236\,v\,(3\,r^2+v^2);$$

which is the identical expression given for the purpose in the books on mensuration. The practical rule is as follows :—

To three times the square of the radius of the base, add the square of the versed sine or height; multiply this sum by the height, and the product again by the constant fraction 0·5236 *for the solidity of the segment.*

ON CERTAIN MECHANICAL FALLACIES.

Sir,—I am rather surprised that the communication of Mr. Dixon, at p. 325 of your last volume, has so long escaped the animadversions of your correspondents; but I confess I should be still more so to learn that Mr. Dixon's invitation to "persons of science" to communicate with him on the subject of his paper had been responded to. Small indeed is the portion of science requisite to enable any one to see that such a proceeding would be quite supererogatory!

Mr. Dixon's proposition is briefly this, to dispense with steam for the propulsion of vessels, and to substitute in its place—what? Why, condensed air! Suppose a person looking over the complicated, but withal symmetrical details, of an extensive manufactory. At length he arrives at the cumbrous, but powerful, water-wheel which actuates the whole. After contemplating for a time its movements, he turns to the proprietor, and with a benignant air thus accosts him. "My dear sir, why *will* you be so needlessly extravagant, and persist in the employment of such expensive means for the working of your machinery?" In reply, the proprietor admits that his water-wheel is expensive, but adds that no other means of performing the work, with which he is acquainted, would be less so; if he knew of such, he has too much at stake to hesitate an instant as to adopting it. "Well, sir," says the sage, "take my advice. Remove your water-wheel with all its appurtenances to-morrow, and substitute for it a revolving spindle!" The proprietor looks at Solon for a little with a puzzled air, as if uncertain whether it be that he has missed the wise man's meaning, or that his own wits have gone a wool-gathering. At length, recollecting himself somewhat, he puts the simple question. "But what is to turn the spindle?" I am not at present in a condition to give you Solon's answer to this question. I shall do so, however, when Mr. Dixon gives *me* an answer to this other question. Supposing we adopt his suggestion, and dispense with the steam-engine, how are we to condense the air?

The case I have supposed is precisely analogous to Mr. Dixon's. In both we are told to do away with the prime mover,—a *generator* of power—and to replace it by a *transmitter* of power! Mr. Dixon belongs to a class, of which the late Mr. John Galt was, and the present Dr. Sleigh, is a type. The class is a very numerous one. That it is so is, I have no doubt, in a great measure owing to the unfortunate name which has been applied to the first elements of machinery —I mean, mechanical *powers*. Those elements, however combined, do in no case give out more power than has been previously supplied to them. The appellation of *powers*, therefore, is peculiarly inappropriate, and seems only to mislead the inexperienced.

While on the subject of fallacies I may briefly point attention to another, an account of which is given in the last No. of your Magazine, p. 105; it is Allen's Patent Priming Preventer. The vessel B is filled with grease (of course in a fluid state), and the inventor says, that when the cocks C and D, *both communicating with the boiler*, and with the vessel B, are opened, "the pressure of the steam from above will force the contents of the vessel B into the boiler." Who does not see that no such effect can possibly take place? The steam certainly will act upon the upper surface of the grease, tending to force it downwards, and so into the boiler through the cock D. But it will also act upon the under surface, through the medium of the water, with precisely the same force; and the consequence will be, that the grease will remain snugly ensconced in the vessel B, where it will extend at a height, as compared with that of the water in the boiler, reciprocally proportional to the specific gravities of the two fluids.

I am, Sir, yours respectfully, G.

Hermes-street, Pentonville, August 16th, 1845.

THE COMPUTATION OF DIRECT DISTANCES.

Sir,—Your nameless correspondent, whom I shall call "A. B.," has given us two rules for solving two of the most important cases in spherical trigonometry (see Nos. 1140, 41, and 43). 1st. When the three sides are given to find an angle; and 2nd, when two sides and the included angle are given to find the third side. "A. B." has given us a formula for each case, neither of which are well-adapted for logarithmic calculation, and both of which require, at the same time, *no less* than three sets of tables, viz.,—1st, a table of the logarithms, sines, and tangents; 2nd, a table of the logarithms of numbers; and 3rd, a table of the natural cosines. Now very few of the common tables contain the natural cosines; and, besides, even with natural cosines at hand, *no less* than eight steps are required to solve either of the cases. If, however, we use this well-known equation, viz.,—

$$\text{cos. } \tfrac{1}{2}\,\text{A} = \sqrt{\frac{\text{sin. } s \text{ sin. } (s-a)}{\text{sin. } b \text{ sin. } c}} = \sqrt{\text{sin. } s \text{ sin. } (s-a) \text{ sec. lat. sec. dec.}}$$

we shall find that it is not only well-adapted for logarithmic calculation; but requires only five steps; and further, that there are no distinctions of cases, and only one table required.

In the above equation, a, b, and c, are the three sides of the triangle

$$s = \frac{a+b+c}{2},$$

and A the angle contained between the sides b and c. "A. B.'s" rule embraces two cases. 1st, when the latitude and declination are of the same name; and 2nd, when they are of contrary names. Now I must tell "A. B." that a case might occur in which, by following his rule, an unscientific calculator would most likely be led into error. For example, suppose the latitude to be 51° 32′ N., the true altitude of the sun's centre, 10° 30′, and the sun's declination 23° 20′ N., and that it is required to find the apparent time of observation, the sun being east of the meridian:—

Solution by "A. B.'s" rule.

Alt. 10° 30′	sin. 9·260633	
Lat. 51° 32′	sec. 0·206168	tan. 0·099914
Dec. 23° 20′	sec. 0·037055	tan. 9·634838
	9·503856	9·734752

Nat. numbers $\left\{ \begin{matrix} 319049 \\ 542940 \end{matrix} \right\}$ subtract.

Nat. cos. H. 223891 77° 3′ 44″.

Therefore, the time angle is either 77° 3′ 44″, or

180° − 77° 3′ 44″ = 102° 56′ 16″.

It is, however, the latter angle that must be taken; because the tan. lat. tan. dec. is greater than sin. alt. sec. dec. sec. lat.; consequently, the cos. H is negative; that is, the time angle is obtuse, and 102° 56′ 16″ = 6 h. 51′ 45″ from noon; and the apparent time of observation, 5 h. 8′ 15″ A.M.

Solution by the preceding equation.

Here a, b, and c are 79° 30′, 38° 28′, and 66° 40′; hence

$$s = \frac{a+b+c}{2} = 92° \ 19',$$

and $s-a$ = 12° 49′.

s = 92° 19′	sin. 9·999645	
$s-a$ = 12° 49′	sin. 9·346024	
Lat. 51° 32′	sec. 0·206168	
Dec. 23° 20′	sec. 0·037055	
	2)19·588892	
$\frac{A}{2}$ 51° 28′ 8″	cos. 9·794446	

∴ A = 102° 56′ 16″, the same as before.

The superiority of this last solution is perfectly apparent.

I shall give another equation for finding the angle A. Let the difference between b and c be called d,

$$\text{sin. } \frac{A}{2} = \sqrt{\text{sin. } \left(\frac{a+d}{2}\right) \text{sin. } \left(\frac{a-d}{2}\right) \text{sec. lat. sec. dec.}}$$

Whether this is a new theorem or not, I cannot tell; the proof for it, however, is very simple.

I am sorry to add that "A. B." has been equally unfortunate in his solution of the 2nd case; but this I will make the subject of another communication.

KINCLAVEN.

August 12, 1845.

MESSRS. NASMYTH AND MAY'S ATMOSPHERIC RAILWAY SYSTEM.

The following interesting elucidation of this system from the pen of Mr. Nasmyth, appears in the *Mining Journal* of last week. We gave the specification of the invention in our Magazine of the 21st June last, and at the same time particularly directed the attention of our readers to the remarkable facts in pneumatics on which it depends.

"In the first place, the object desired to be attained is, to remove the air entirely from the interior of certain large chambers, so that they may, as it were, become vast magazines of vacuum. The ordinary mode of doing this, is to *pump* out the air by air-pumps, which receive their power from a vacuum, created above or below the piston of a steam engine. The principle I set out upon is simply this—why employ one vacuum to create another? when we could, by the primary process, attain the desired object, without the intervention of any secondary action, or machinery, whatsoever. Now let us examine how this is best to be done. One cubic foot of water, converted into low-pressure steam, will, in round numbers, yield 1700 cubic feet of steam, which will be capable (on being introduced at the upper end of an *upright* air-tight vessel) of displacing, or forcing out at an aperture below 1700 cubic feet of air; if we now stop the further influx of steam, and close the aperture below, and either permit the steam to condense, *per se*, or perform that duty by a separate condenser, we shall have for our 1700 feet of steam, 1700 feet of *very nearly perfect vacuum* (supposing, of course, that our vessel was exactly 1700 cubic feet capacity). Now, if we suppose a communication opened between this magazine of 1700 cubic feet of vacuum, and an atmospheric railway pipe of similar capacity, we shall abstract one-half of its contents of air, and at once reduce it to the state of a vacuum of 7½ lbs. to the square inch, or thereabouts. Here, then, we have done some work, so far, with our first 1700 cubic feet of steam. It will be evident that the remaining vacuum in the exhausting chamber, and that in the pipe it has partially exhausted, will be similar in extent—namely, each a half perfect vacuum. Now, let us suppose that we have, during the performance of this operation discharged the air from a second chamber of like capacity to the first—viz., 1700 cubic feet, and that that vessel is just filled with steam on a balance with the atmosphere; if *before* opening the communication between our condenser and this steam-filled vessel, we first open a communication between it and our first vessel, which, as before described, is in the state of half vacuum, it is evident that this first vessel will abstract from the steam-filled vessel a very large portion of steam, until the two are then on a balance; on this simple system of mutual transfer we not only employ the first vessel to act on the second, as a preliminary condenser, but also, as it were, use the steam of the second vessel in great part *twice over*, inasmuch as this transferred steam will so far act the same as fresh steam from the boiler, in satisfying the wants of the first, or "used up" chamber; this being the case, the second vessel has its vacuum rendered complete, by being brought into communication with the condenser, while the first vessel has its complement of steam made up direct from the boiler, which steam, flowing in at the upper end, performs the air discharging office to perfection. I fear, in my attempts to render my system easily understood, I have made what is in reality a most simple and rapid action, appear complex and tedious of performance; but in point of fact, the whole process of displacing the air, condensing the steam which displaced that air, and the transfer of the steam from the one to the other, will be the work of some twenty or thirty seconds of time; and as the vessels which I propose to employ will be upwards of 150 feet in height, and ten feet in diameter, four in number, standing close together inside a tower, we shall have, by their combined action, a magazine of vacuum of remarkable perfection, of the vast capacity of 46,800 cubic feet, which would be capable of exhausting seven miles of fifteen inch atmospheric pipe *at one masterly stroke, in a few seconds*, producing, in that seven miles of pipe, a vacuum equal to 7 lbs. to the inch, which is quite ample for all the purposes of atmospheric railway locomotion. These vacuum chambers, or vessels, will be formed of boiler plate, and lined inside and outside with wood, to prevent any loss of heat, it being important to maintain the chambers near the heat of boiling water, so as not to cause any undue loss of steam—this, however, is a very simple affair.

From actual experiments I have made, I find that when low-pressure steam, say ½ lb. to the square inch, is permitted to flow in at the upper end of a tall upright vessel, having an opening below, the included column of air is depressed and forced out with the utmost ease and rapidity, while at the same time, there is no appreciable mix-

ture between the steam and air, the two preserving the most remarkable distinctness of separation. This, in fact, forms the grand principle on which I act—namely, the *vertical* displacement of the column of air by low-pressure steam. At all times it will be most convenient to employ the time between the running of the trains, to prepare the magazine of vacuum all ready for instant action at any moment's notice; in this way a comparatively small boiler will answer. I may mention, that one grand advantage of having a ready-made store of vacuum at hand is, that the closing of the long valve is performed effectually the instant the communication is formed between the vacuum chambers and the atmospheric pipe; this will obviate much source of loss from leakage, which continues so long when the vacuum is produced by the comparatively gradual process of pumping out the air by the ordinary system. I trust the time is not now far distant, when a full-sized, and, therefore, true experiment, will be made, to test, by actual practice, the comparative merits of my direct system, with that of the steam-engine and air-pump system, by erecting a set of my vacuum chambers alongside one of the engines about to be employed on some of the atmospheric railways, obtaining the required steam for my system from the identical boiler, and working the two systems month about, and taking exact account of the coal consumed by each: I should stand or fall by such a true experiment as this, which is beyond all abstract investigations in getting at the real truth."

THE ATMOSPHERIC RAILWAY SYSTEM—APPENDIX TO MR. BARLOW'S PAPER, AND DISCUSSION AT THE INSTITUTION OF CIVIL ENGINEERS.

The paper by Mr. Barlow, of which we gave an abstract in our last Number, was accompanied by an Appendix of Experiments, the substance of which we also subjoin:—

Experiments on the Tyler Hill Inclined Plane of the Canterbury and Whitstable Railway, showing the relative amount of lost Power of the Rope Traction, as compared with that of the Atmospheric System, on the Dalkey Inclined Plane.

The Canterbury and Whitstable railway was constructed in the year 1830, and was the first railway in the South of England. It was intended to be worked by stationary power, and is composed chiefly of inclined planes of various inclinations, from 1 in 36 to 1 in 50. The inclined plane at Tyler Hill, where the experiments were tried, is 1 mile and 70 chains in length, with an average inclination of 1 in 48.

The stationary engine is of 25 horses (commercial) power, with a cylinder 20⅝ inches diameter and 5 feet stroke, and was erected by Messrs. Stephenson of Newcastle, in the year 1830. It will bring up 35 tons at an average rate of 7½ miles per hour, on the incline of 1 in 48, and is, therefore, capable of producing as great a useful mechanical effect as the Dalkey engine of 100 h.p., as it raises more than half the load three times the altitude, on the same length of incline, in nearly the same interval of time.

With a result so important and unexpected, it was necessary, in order to render the deductions perfectly satisfactory, to adopt every practical means of ascertaining the exact power exerted during the experiment; an indicator and counter were therefore attached to the engine.

The slide valves of the engine were very inaccurately set during the first seven experiments;—the eighth was made the next day, after the slides had been adjusted; this experiment, therefore, shows a better result. Further alterations of the slides, had it been possible to have made them, within the time allotted for these experiments, would have ensured still more satisfactory results.

Much misapprehension has prevailed from comparing the atmospheric with the locomotive system, in consequence of using the same arguments as were brought forward in favour of the stationary power, and it will be apparent, from reading the Report of the Atmospheric Committee,* that they have been misled by these arguments, and that they would have arrived at the same conclusions if they had been considering the system of stationary engine and rope traction, and for precisely the same reasons. A comparison of the atmospheric system with that of rope traction is therefore important, in order to ascertain the practicability, or the applicability of the atmospheric system. These experiments may, it is contended, be received as strong arguments against the commercial practicability of the atmospheric system.†

The exact inclination of each portion of the plane was accurately ascertained, posts were placed at intervals of 5 chains, and the time of passing each post was carefully registered. The tables of experiments give the weights of the carriages and load of each train, the number of revolutions of the engine, the speed of the piston per minute, the average pressure upon the piston, the

* For this Report see *Mech. Mag.* vol. xlii. p. 293.

† The experiments were entrusted to Mr. Gastineau, who followed with great accuracy the author's instructions.

pressure in the boiler, and the estimated power of the engine.

From these comparative tables the following results are obtained.

1st. That an engine of 25 commercial h.p. on the Whitstable line, working at an average of 50 h.p. of 33,000 lbs., gives a useful mechanical result, nearly equal to the Dalkey engine of 100 commercial h.p., working at 160 h.p.; or in other words, it raises trains of 30 tons on an incline of 1 in 48, at the same speed that the Dalkey engine raises trains of 66 tons on an incline of 1 in 138, which is evidently nearly an equal mechanical effect.

2ndly. That the lost power on the Whitstable Incline averages four-tenths of the whole power, while on the Dalkey line it averages eight-tenths of the whole power.

3rdly. That the loss in transmitting the power to the train, as shown in Mr. Samuda's experiments, exceeds eight-tenths of the whole power, while in his statement sent to the Committee it was estimated at one-seventh, which explains the difference in the calculations of the power required on the atmospheric lines.

4thly. The amount of lost power appears, in Mr. Stephenson's experiments, to be nearly uniform, throughout all the degrees of vacuum; this at first sight appears extraordinary, but it is evidently caused by the circumstance of the useful mechanical effect being computed by multiplying the resistance due to friction and gravity into the mean velocity in feet, without regarding the resistance of the air, which was greater with the low degrees of vacuum, because the velocities were greater.

It is, however, difficult to estimate this, as the velocities were variable; but assuming 20 lbs. as adopted by Mr. Stephenson, for 30 miles per hour, it will affect the result, to the amount of about 25 per cent., which may be taken as an approximation to the truth; but whatever it may be, it is evident, from the uniformity of the results, that the effect of the increased leakage, at the higher degrees of vacuum, does not exceed the increased resistance of the air, and thereby proves that the leakage is not the main source of lost power.

The experiments by Mr. Samuda and M. Mallet show a less mechanical effect than those by Mr. Stephenson; which arises evidently from their holding the train by the breaks until the vacuum was made, in order to obtain as great a maximum speed as possible.

With a result showing so large an amount of lost power, it becomes interesting to enquire to what it is to be attributed, and how the total amount is made up; but this would require experiments more especially devoted to that question. It is, however, evident that a large portion is of a description which (although not lost in a theoretical point of view) is not under mechanical control, either with heavy or light loads.

With heavy loads and a high vacuum, the power of the engine required to form the vacuum will amount to the greater proportion of the whole power exerted, and which will be practically lost; with the other extreme, of light loads and a small vacuum, the friction of the air in the pipe becomes an equally large proportion of the power expended, because the whole bulk of air must be exhausted, however small the load may be. In fact, the atmospheric medium of traction may be practically represented by a rope without weight, but so extremely elastic, that with a high vacuum the larger proportion of the power of the engine is required to give it sufficient tension to sustain the required load. With small loads, the friction of the air on the sides of the tube will also form a large proportion of the power exerted by the engine, so that there will be one particular vacuum and load, with any given engine and pipe, in which the sum of these losses will become the least possible; but whatever this may be, it is evident the amount must be fatal to the atmospheric system as a mode of applying stationary power.

There is also a loss of power necessarily arising from the construction of the air-pump, and, in addition to that from leakage, there will be a certain loss from the atmosphere not having time to act with full effect on the piston.

It must be apparent, that the loss from leakage does not form a large proportion of the lost power, and there is, therefore, but little field for mechanical improvements, which has been urged as an argument in favour of the system.

This loss of time and of power, from the interval necessary to get up the required vacuum, will have the effect of reducing the average rate of travelling on a single line of atmospheric pipe, considerably below that of a locomotive line; because such loss of time must occur at the meeting of every train, and with trains running at intervals of half an hour, this delay must necessarily occur every quarter of an hour.

Let A, B, C, D, in the annexed diagram, represent the position of the engines on an atmospheric line, the first section, A to B, being similar to the Dalkey line.

A . B . . C . . D .

0 1 2 3 . 4 5 6 miles.

The best result obtained from the experiments on the Dalkey line was the transport of a train of 30 tons in five minutes. Now, assuming three trains per hour to be required, if there was only one engine, the train, when it arrived at B, would have to wait five minutes, which would make the total time of traversing 1¾ miles ten minutes, being an average speed of 10½ miles per hour, although the extreme speed may have reached 35 miles per hour. If the engines at B, C, D, were double engines, the average speed would be doubled with double the number of trains.

From this it appears, that on a railway formed of sections similar to the Dalkey line, with single engines, or 100 h. p. (of 33,000 lbs.) per mile, a train of 30 tons would make three-trips each way per hour, at an average speed of 10½ miles; and if the engines were double (*i. e.* 200 h. p. per mile), six trips each way per hour might be effected, at an average speed of 21 miles per hour, which is the simplest case of a long line.

In the proposed atmospheric lines, the power is intended to be arranged as shown in the annexed diagram.

A B C D E F G

Single . Eng. Dble. . . Eng. Single . . Eng. Dble. . . Eng. Single . Eng. Dble. . . Eng.

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 miles.

The length of the section A to B 2½ miles, double engines being placed at alternate sections. Now, assuming the most favourable case, of no increase of leakage, or friction, from the increased length, it will be found that, with engines at B and C, of similar power to that at Dalkey, it would be requisite, in order to transport a train of 30 tons from A to C,

To obtain a vacuum at A = to 13 lbs. per square inch	3·57 minutes.
To pass from A to C, at a speed of 30 miles per hour	10· ,,
Allow for irregularity of meeting	1·43 ,,
Total	15 minutes.

Therefore, in a line with meeting points every five miles, with similar gradients and power to the Dalkey line, *i. e.* 105 h. p. per mile (without spare engines), the greatest effect will be to transport trains of 30 tons every half-hour, at an average speed of 30 miles; which is evidently an insufficient power to insure punctuality with the ordinary traffic of a railway.

[Here follow in a tabulated form the experiments with the Tyler Hill Engine, illustrated by indicator diagrams; after which comes a Table, which we shall give next week, exhibiting the general results as contrasted with those furnished by the Dalkey Engine.]

The Discussion.

Mr. Joseph Samuda must be permitted to say, that he thought the author of the paper had scarcely entered fairly into the examination of the system, as the statement was made up entirely of the demerits of the plan, without giving it credit for the success, which had already attended its first establishment. Several of the objections were made, evidently without a knowledge of how the apparent difficulties in the application were proposed to be overcome, or were actually avoided. He would instance only a few points, and leave to others, better qualified than he was, the task of refuting the charge of impossibility. It was not proposed to use any other than the engines of the main line, for working the sidings, which could be laid in, without at all interfering with the continuity of the main line. Level crossings were quite as practicable as on locomotive lines. There was even an additional security, as by a simple contrivance, consisting of a cylinder and piston connected with the main pipe, the platform which, when down, formed the protection of the valve, under the crossing, could be raised when the vacuum was being formed, and thus, not only became a signal that a train was about to pass, but also formed a barrier, for preventing anything from traversing at an inopportune moment. He could not understand the necessity for bringing two trains together, as had been assumed; but if that did occur, a little extra power might be used in that particular instance, in the same way as in an emergency, another locomotive would be added to the ordinary train engine. As respected the liability to be thrown off the rails by impediments, he must contend, that the position assumed was not supported by facts. On the Dalkey line, there were curves of 130 yards radius, which were constantly traversed at a speed of 35 miles per hour! yet no accident had occurred. It was well known that locomotive engines were not in the habit of traversing curves of that radius, at such a speed. He could not agree with the statement of the comparative cost of the two systems. He thought that the author had underrated the actual cost of locomotive haulage; while he had overrated, not only the cost of that by the atmospheric system but also the amount of power employed

for instance, with a gross load of 75 tons, not more than two-thirds of the actual power of the engine were employed, as was shown by the indicator diagrams. In the statement of the cost of construction, Mr. Samuda's experience was equally at variance with the assertions of the author. As regarded the probable expense of the maintenance of the way, on new atmospheric railways; it must be remembered, that the Dalkey line was quite new, but it had worked through the winter without any stoppage, either from subsidence, or from slips, and it was kept in order with as little difficulty as the part which was worked by locomotive engines. It should not be assumed that the system was not susceptible of modification, to accommodate itself to any amount of traffic. Mr. Samuda must, on the contrary, assert that any economical arrangements which were practicable with the locomotive system, might be adopted with the atmospheric plan. For instance, if it was found desirable to have trains at long intervals, the obvious plan would be, to substitute, for a powerful engine, a small power, to pump water into a reservoir, which, during the time necessary for forming the vacuum, should exert a considerable power upon a water-wheel. The system was capable of being economically adapted to almost any locality, where there was sufficient traffic to warrant the formation of a railway.

Mr. P. W. Barlow stated, that his object in presenting the paper to the Institution, was not to attack the atmospheric system, but simply to suggest, for the consideration of the members, certain objections with reference to it, which appeared to him proper subjects for discussion. As to the sidings, he did not contend that it was impossible to apply them, in a mechanical point of view; but that they would lead to great inconvenience, and be inconsistent with practice. It could only be done (unless the crossing were divided) by raising the piston above the level of the rails, which would be inconvenient, from want of space under the carriages. With reference to the comparative advantage of obtaining ten miles of pipe in one length, it would be desirable in one respect, as permitting a less number of stationary engines, and as saving working expenses; but it would be objectionable, inasmuch as it would increase the loss of time which necessarily occurred, when the trains met on a single line, from the time requisite to exhaust the air out of the pipe to the next station, which would require twenty minutes.

Mr. Pim professed a high respect, not only for the speculative views of the theorist, but also for the examination of the practical man; but he thought the theory of subjects like the present should not be examined, until after careful observation of the actual practical working of the system, as it was notorious how the results of the soundest theory were modified by a slight alteration in the practical condition of the machine, or system. It was to be regretted, that the author had not made himself better acquainted with the results obtained on the Dalkey line, where any information he required would have been readily afforded to him. He would then have seen, that several of his objections did not, in fact, exist. It would suffice to mention a very few. The leading carriage being tied down to the line, by its connexion with the piston, was sufficient of itself to prevent any tendency to run off the rails, even on the sharpest curves. On one occasion, owing to the carelessness of an attendant, the leading carriage, with the piston, became detached from the train, and travelled up to Dalkey in perfect safety, at a velocity of nearly seventy miles per hour. There were many omissions in the paper, which savoured somewhat of a strong bias against the atmospheric system. The degree of speed which could be attained with such safety was not noticed. There was not a word as to avoiding the chance of collision, when it was notorious that a collision was utterly and physically impossible. In stating that the dimensions of the tunnels were regulated by the height of the pile of goods on the luggage trains, it did not appear to have struck the author that it was possible to reduce that height, and, at the same time, to carry as great a load in a more advantageous form. Mr. Pim was of opinion, that the introduction of the atmospheric principle would produce an entire change in railway traffic, as it would be found, that frequent and light trains were more advantageous, both to the railway company and to the public, than heavy trains at long intervals. The public would very soon have an opportunity of judging practically as to the merits of the system, and his confidence in its advantages was not at all shaken by the statements he had heard in the paper. On the contrary, he had much more confidence in the results, which he felt assured would be attained, by the skill of the two able engineers who were then constructing lines on the atmospheric system.

Mr. P. W. Barlow said, the practical results of the working on the Dalkey line showed, that the tractive power of the stationary engine, as applied by the atmospheric pipe, was about equal to that of an ordinary goods engine used on railways; or the same amount of work could be performed in the same time by one of those engines, and that

the consumption of fuel, during the actual motion of the train, was at least equal to that used by the locomotive, which was 40 lbs. per mile; consequently, with the loss from obtaining the vacuum, and constantly keeping up the steam of the stationary engine, no economy in working could be obtained, under any circumstances, unless greater perfection were obtained in the application of the atmospheric principle; and it was doubtful if the Dalkey line, with its advantageous incline and numerous trains, could not be more economically worked by locomotive engines.

Mr. C. H. Gregory said, that without wishing to depreciate Mr. Barlow's interesting paper, there were some points in it, not noticed by previous speakers, which, he would submit, required correction. Mr. Barlow had stated, that in the comparison he had instituted, the atmospheric engine had consumed 40 lbs. of fuel per mile, and that an equal weight was consumed by a locomotive goods engine, under similar circumstances; but it did not appear that any allowance had been made by him for the difference in cost between coal used in the atmospheric and coke in the locomotive system. He thought too, that a comparison between the two systems ought to include a notice of the great difference between the wear and tear of locomotive and stationary engines, which would be much in favour of the latter. The comparison had been made between the working of the two systems at a slow speed, which he believed was not so favourable to the atmospheric system, where a greater speed would show comparatively greater economy, while it was well-known that high velocities induced a great loss of power in locomotive engines. In illustration of this fact he alluded to some indications which had been taken by M. Gouin, a French engineer, in the cylinders of locomotive engines at different velocities. In these it was shown that when the engines were running at slow speed, nearly the whole pressure of the steam had been effective in the cylinders; while, at high speeds, the indication showed a loss in the cylinders alone, amounting to about fifty per cent. of the pressure. This result was in addition to all the acknowledged mechanical defects of locomotive engines at high velocities.

Mr. P. W. Barlow explained, that he did not contend that high velocities could not be obtained on short lines, or between stations; but on long lines, when the trains met, each train must wait, until the air was exhausted out of the next length of pipe, which would reduce the speed, in practice, to 20 miles per hour.

Mr. I. K. Brunel did not appear either as a supporter of the atmospheric system, or as wishing to condemn it; but he thought it due to the inventors, that those who were about to use it should not be entirely silent. The paper appeared to him, rather a list of objections to the plan, than an examination of its comparative value as a method of propulsion; and he must say, that these objections did not seem to be supported by calculation, or by argument. Mr. Brunel was quite prepared to admit, that there were many situations to which the system in its present state was inapplicable; but as a practical man, he clearly perceived the manner of remedying many of the alleged defects; and, without that feeling, he should have had considerable hesitation in recommending its adoption. He thought, also, that many of the presumed deficiencies did not really exist; for instance, upon the atmospheric line now being established in Devonshire, there would be numerous stations, in which he anticipated doing all the station work, with as much facility as with locomotives, and even more conveniently. He did not anticipate any difficulty in transmitting special trains and expresses, but, on the contrary, he believed that the impossibility of collision would induce peculiar facility in that respect. He thought, that instead of the stoppages reducing the average speed below that of locomotives, say to 20 miles per hour, double that speed would be certainly attained. He could not agree, that because the system had hitherto only been practised on a short line, it was inapplicable to long lines; calculations proved the reverse, and it would be only just to await the result of the practical working of the lines, now in course of execution. He was of opinion, that by the use of large boilers, fixed on the most approved plan, by husbanding the power, working the steam expansively, and using the present known improvements in stationary engines, the system would prove as economical, as it was free from danger.

Mr. Cubitt, V. P., thought, that any assertions as to the capabilities or powers of the system, were, in its present state, very inconclusive and scarcely fair, and the best manner of confuting the positions of the paper was to have a line at work, which would, he hoped, be accomplished without much delay. He must, however, be permitted to say, that the mechanical difficulties of the level crossings, sidings, &c., were met by simple mechanical means. The real questions were the first outlay, and the cost of working, and they could only be decided by actual experience.

Mr. John Scott Russell was neither a prejudiced adversary, nor a headlong advocate, of the atmospheric system. He agreed

in the opinion already expressed, that any discussion on points which were soon to be submitted to the test of experience, was of comparatively small value. One important service, however, had been already rendered by the discussion, in having elicited the statements of two eminent engineers, who were then engaged in carrying out the practical application of the atmospheric principle on a large scale. They had stated, that all those difficulties, which had been mentioned in the paper, had been foreseen by them, and had been conquered. This fact was important, for it was most desirable that any opposition to the atmospheric system should be based on right grounds, and not upon mere prejudice. The paper had pointed out, with much ingenuity, the minor practical difficulties in the way of the execution and the use of the atmospheric railway; but these he did not at all regard as objections to the system, but merely as the statement of problems, of which the ingenuity of the promoters, in constructing the works, had to invent the solution. Now he thought it only fair to say, that seeing the atmospheric system in the hands of such mechanics as Mr. Cubitt and Mr. Brunel, he had no hesitation in expressing his conviction, that they must have seen their way clearly to sound practical solutions, for all their mechanical difficulties, or they never would have risked their reputation on the construction of such lines. Although he was himself much inferior to them as a mechanic, he could see his way clearly to the solution of many of the difficulties stated in the ingenious paper of Mr. Barlow, and he had such faith in the powers of invention of the engineers of this country, and in the mechanical skill and powers of execution of the workmen, that he had no doubt if the atmospheric system was sound at heart, and in its principle, all these minor evils would disappear. On the faith, therefore, of the talent of these engineers, he would give the system credit for all that their skill could devise, and he had no doubt that they would overcome the mechanical difficulties of practical execution. But there remained the great question of the value of the system as a general system of traction, applicable on all railways, and capable of superseding the locomotive engine. It was on this general ground that the question must be decided, and here the result, he thought, was perfectly clear. The atmospheric system was merely one among many modifications of stationary power. As such, while it possessed the advantages, it must encounter, all the evils of the stationary system, and on this broad ground, that the stationary system was neither so economical, nor so convenient, as the locomotive system, he rejected the proposition of the inventors, who wished to substitute stationary atmospheric for locomotive engine power, generally, on railroads. But in justice to the system, and to those who had adopted it, he ought to say, that he had no doubt, that in cases where stationary power was desirable, there were circumstances which might render the atmospheric system peculiarly appropriate. Selecting, for instance, a line where there were many or sharp curves, or many inclines of variable and steep gradients, and where also the trains were numerous, uniform in magnitude and number; such a case was most favourable to stationary power, and to the atmospheric system especially. He thought it would have been wiser if the inventors of the system had brought it forward as an expedient of this kind, suited to these circumstances, rather than as a revolutionary system, proposing to displace locomotives on all the great railways of the country. In that case, they would have received the support of many, who now could not accord with their views. In that modified application he would be happy to see it successful, and he thought the wiser promoters of the system were of his opinion, for it was in peculiar circumstances, of the nature he had indicated, that they were about to introduce it. He should be glad to learn from those engineers who were about to introduce the system, whether they would assure him, that in the application of the system there was no loss incurred in the use of the air as the means of applying the power. He conceived there must be a mechanical loss of power, in the process of first rarifying the air, and afterwards condensing it.

Mr. Pim said, that it was not for him to enter into an analysis of the theory of the atmospheric system, but his belief in its correctness was in a great degree confirmed by the investigation of Dr. Robinson of Armagh, who had arrived at diametrically opposite results from Mr. Russell. He could, however, judge of the practical results; and when comparing the actual speed and cost of propulsion on the Dublin and Kingston railway, with that of the Kingston and Dalkey line, the result was decidedly in favour of the latter; on the former, with locomotive engines, ¾ mile with a rise of 13 feet, was traversed in 4 minutes; while on the latter, with the atmospheric system, 1 mile with a rise of 71½ feet and several sharp curves, was passed over in a little more than 3 minutes: the consumption of steam in the Dalkey engine was, at the same time, much less than in a locomotive.

Mr. Cubitt, V.P., thought that it was not incumbent on the advocates of the system to show, that it was perfect as a mechanical power. It sufficed to show, that it was superior to fixed engines and ropes, which had been attempted to be substituted for locomotives, not only on account of their cost of steam and fuel whilst travelling, but also because of their excessive tear and wear.

If, as had been asserted by a great railway authority, the power required to move the engine and tender, equalled that requisite for drawing fifteen passenger carriages, which was more than an average train, it would follow, that it would cost more to move the engine and tender than the average of all the passenger trains. If, therefore, the traffic could be conveyed by the atmospheric system at a less expense, a great point would be gained.

Mr. J. Scott Russell gathered from what Mr. Pim had said, that it appeared from Dr. Robinson's calculations, that the power expended, and the power usefully applied, were theoretically precisely equal. Mr. Russell had not arrived at the same conclusion, and he would desire to ascertain, whether the engineers intending to use the system and who had doubtless examined the subject carefully, agreed with Dr. Robinson's view, or entertained a more modified opinion of it.

Mr. J. Samuda could not admit Mr. Russell's view of the loss of power. He contended, on the contrary, that the power primarily expended in forming the vacuum, was returned during the passage of the train. When the air-pumps were working at 15 inches of mercury, with a pressure of 4½ lbs. per square inch on the piston of the steam cylinder, a power was attained in the pipe, equal to 7½ lbs. per square inch upon the travelling piston.

Mr. I. K. Brunel contended also, that a loss of power to the extent that had been stated could not be proved, when a certain amount of work was performed with the expenditure of a certain power. He would admit, that some loss might arise from the absorption of heat, during the process of rarefying the air in the main, but he could not concur in the position assumed by Mr. Russell.

PROPERTIES OF THE CYLINDRICAL RING.

Sir,—The plane sections of a cone and a right cylinder are well known, but perhaps not those of the cylindrical ring, in all their varieties.

Now, from any of these plane sections, let it be supposed that there is the least possible deviation. For example, instead of a cone being cut by a plane, to produce any of its well known sections, let the section be in the least, or any degree, cylindrical, either convex or concave with any plane section of the cone.

For a particular example, let a cylinder, to half its diameter, cut a cone parallel to its side; and let the straight line in the direction of the length, equally dividing the surface of the embedded portion of the cylinder, be the axis of a parabolic section.

Next consider the orthographical projection of the line of intersection of the cylinder and cone; then suppose the line to be traced on the surface of the cylinder; and further, suppose so much of the cylindrical surface to be enveloped on the plane of the parabola.

Here are three distinct lines having inferior branches; viz.

1st. The parabola.

2nd. The periphery of the envelope.

3rd. Orthographical projection.

The distance between the branches of the parabola, if indefinitely extended, becomes immeasurable.

The distance between the branches of the envelope, in this case, although always increasing as they are extended, never can exceed half the circumference of the cylinder; and the distance between the branches of the orthographical projection, although, also, continually increasing as they are produced, can never exceed the diameter of the cylinder.

These last two lines so much resemble some of the lines produced by a motion, the reciprocals of that by which some of the conchoids are produced, that I hope they may lead to an easy method of determining of what solids many of the other lines of the septenary system, are sections, envelopes, or projections, both of lines with infinite branches, and such as return into themselves.

I am, yours, &c.,

Joseph Jopling.

29, Wimpole-street, August 16th, 1845.

THE "QUEEN" STEAMER—PADDLE-WHEELS AND DIRECT-ACTION ENGINES.

Sir,—Having read with more than ordinary interest the report of the trials of the *Fairy* screw steamer at Long Reach, together with her trial of speed with the *Meteor*, and feeling assured that many of your corres-

pondents take equal interest in the progressive improvement of our river steamers, I am induced to send you a statement of the performances of a third vessel, which has indubitably eclipsed both of those above-named. I refer to the *Queen*, which was built and fitted with her machinery and paddle-wheels by Messrs. Rennie, in the year 1841. Her power having been found too small to produce the most satisfactory speed, when laden with an average number of passengers, Messrs. Rennie have this year fitted her with a pair of new direct-action engines, and the result of the alteration has produced a most marked improvement in her speed. The engines were first tried down the river on Tuesday, the 5th instant, and again on Sunday, the 10th; and on Friday last the vessel was taken to Long Reach, in order to ascertain her speed at the measured mile. The result of four trials up and down gave a mean of 17·761 miles per hour. In the course of these trials, the following vessels of known first-rate speed were competed with, and all beat in the most satisfactory and decisive manner, viz., the *Sapphire*, *Railway*, *Hern*, and *Meteor*. The latter vessel, although admitted to be the fastest on the river, was beat 3½ minutes in a run of 27 minutes. On Saturday last she was put in competition with the *Prince of Wales*, Margate steamer; when, although the *Prince* had her foresail and trysail set, the *Queen* beat her, in a run of 40 minutes, a full mile and three-quarters. Indeed, the speed of the *Queen*, since she has been fitted with her present machinery, is such as to pronounce her the fastest vessel afloat; and this satisfactory result has been produced without the intervention of patent engines of any kind—simply with a pair of direct action engines, with a short stroke, and short connecting-rod, a description of engine which Mr. Alexander Gordon has laboured hard to convince the world is perfectly useless!

I omitted to mention, that on the *Queen's* trip up from Gravesend, on Saturday last, she left the Town Pier at 2 o'clock, and at 21 minutes past 3 she was alongside the Brunswick Wharf, Blackwall; doing 20¼ miles in 81 minutes, against a strong ebb spring tide, and a stiff head wind.

I am, Sir, your obedient servant, L. S.

London, August 19, 1845.

NOTES AND NOTICES.

New Railway Velocipede.—Mr. R. Jones, of the Scoint Iron Foundry, Carnarvon, has recently constructed a new locomotive, combining the principle of the velocipede with that of a carriage, capable of carrying twelve persons. The machine is intended to propel a carriage along the Padarn Railway, but is also adapted for traversing the rails alone. The present is an improvement on the velocipedes previously constructed by Mr. Jones, for the quarrymen on the line—they being worked by the feet only, while the labour is now divided equally between the feet and hands—the motion being induced by handles and pedals, and is so facile in its movement, that a child can impel it rapidly to or fro at will. The machine is wholly composed of iron, and weighs about half a ton.—*Mining Journal.*

The Hayle Engine Works.—Messrs. Harvey and Co. have nearly executed an order for six fly-wheels for the South Devon railway, measuring 20 feet in diameter, and each wheel weighing near 14 tons. Two of them have been sent to their destination, and the other four are in a great state of forwardness.—Letters from Haarlem announce that the *Mammoth* engine has been put to work, much to the satisfaction of the proprietors and engineers. An order is expected soon for two engines of the same size, and on a similar construction.—*Falmouth Packet.*

An Atomic Vagary.—The *New York Mirror* gives the following as the substance of a lecture lately delivered in that city by a certain Professor Bronson:—"If a drop of human blood be subjected to examination by the oxhydrogen microscope, and magnified *some twenty millions of times* (only) all the species of animals now existing on the earth, or that have existed during the different stages of creation for millions of years past will there be discovered. In the blood of a healthy person all the animalcules are quiet and peaceable; but in the blood of a diseased person they are furious, raging, and preying upon each other. This he stated in illustration of his position that man contains within himself all the principles of the universe. It was also asserted that if a dead cat be thrown into a pool of stagnant water, and allowed to dissolve there, a drop of water taken from any part of the pool, and examined as above, will show every species of animal of the cat kind that has ever existed on the earth, raging and destroying one another. The bodies of all the lower animals being thus made up of animalcules similar to themselves, and the body of man being compounded of all that is below him in the scale of creation!"

Growth of Silk at Norwich.—A person named Leeds, a working cooper, living in St. Edmunds, Norwich, has this year about 10,000 silk worms, which have just commenced spinning in a room at the top of his house, without any artificial heat; they have been this year in the most healthy state, he having lost scarcely twenty from the time of hatching. Mr. Leeds has now materials for several splendid silk dresses, one of which is contemplated to send to Her Majesty.—*Chelmsford Chronicle.*

Manufactures in Canada.—The *Montreal Herald* lately mentioned the receipt of grey domestic cloth from the Chambly Factory, it being the first sample of the results of manufacturing enterprise, as applied to weaving by machinery, in Lower Canada; and since then, another and a similar specimen, in the shape of half a dozen hanks of cotton twist, from the factory lately established at Sherbrooke, in the Eastern Townships, has been shown. The twist is of superior quality, and can be afforded to the purchaser at a lower rate than the same quality imported either from England or the United States. There is no country in North America better adapted for manufactures than Lower Canada, from the extent of her water-power, and the comparative density of her population.

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1151.] SATURDAY, AUGUST 30, 1845. [Price 3*d*.

Edited by J. C. Robertson, No. 166, Fleet-street.

SIR GEORGE CAYLEY'S RAILWAY-TRAIN BUFFER CARRIAGE.

Fig. 1

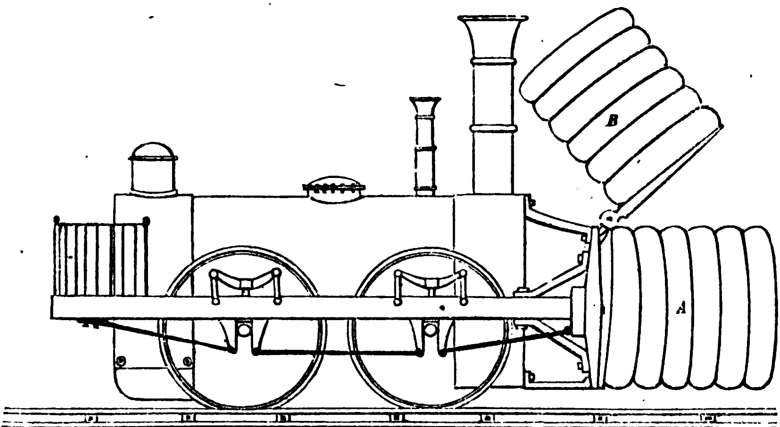
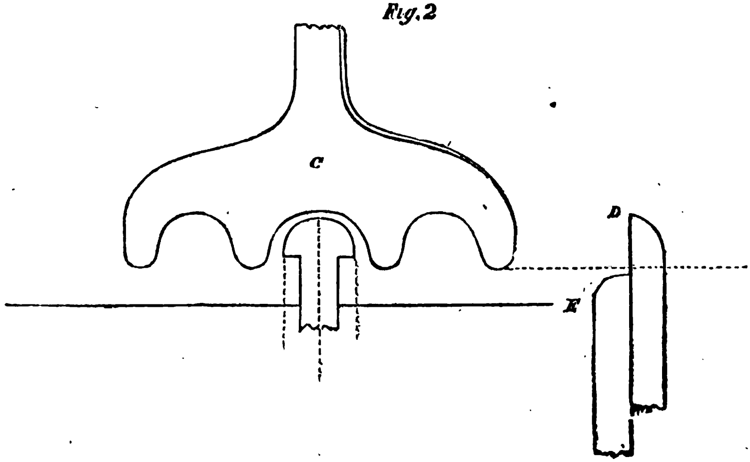


Fig. 2



DESCRIPTION OF A TRAIN BUFFER CARRIAGE FOR THE PREVENTION OF ACCIDENTS ON RAILWAYS. BY SIR GEORGE CAYLEY, BART.

Sir,—Permit me through your valuable Magazine to call the attention of the public once more to the means of preventing those horrible railway accidents that seem to be accumulating in an accelerated ratio as an accompaniment to the accelerated velocity now adopted. It may be said, perhaps, that as crows only fly at twenty-four miles per hour, men, not born with wings, ought to be contented to rival in speed those so gifted by nature; and that if they will not be so contented, they should not grumble at the consequences. Still it is our duty, looking at things as they are, to render the risk the least possible. In every attempt of this sort we are invariably met by the present construction of all the enormously expensive apparatus belonging to railroads, and the question is narrowed, not into what might be done on new constructions, but what can be done with little additional cost on the present ones. Certainly some general buffer for every train, must sooner or later, either by the voluntary act of the companies or by the compulsory order of the legislature, be adopted. In my former papers* I have proposed a machine of this sort, by having a huge air cylinder and piston placed on wheels; and I still think some modification of that principle, under the advice of our very competent engineers, will be the best way to meet the case.† In the mean time, and if we cannot effect the whole, let us try to do a part of the good, by having a series of large cushions or mattresses well packed with some elastic material placed in front of every engine, as represented by A, fig. 1. This may be attached to a hinged tablet or plate, so as to avoid inconvenient length. When on the turning platforms it may be placed in the position B. The little additional weight on the front wheels caused by this buffer will not be of any material consequence, and it would prevent many an injury, though not possibly qualified to meet extreme cases. But in the present state of things, "bis dat qui cito dat."

* See *Mech. Mag.*, vol. xxxvi. p. 397.

† The wish of our esteemed correspondent is likely to be soon gratified. Mr. H. S. Rayner, of Ripley, has recently obtained a patent for a system of railway buffers, which will, we believe, fully meet all the difficulties of the case.—Ed. M. M.

It seems from experience, that the natural tendency of so great a mass of matter as that of a locomotive engine to preserve the right line of its course is such, that, when opposed by the carcase of a cow, or the fragments of the gate, which it smashes in its impetuous course, it generally falls again within the rails; and to obviate those serious accidents that occur from the engine running off the rails, it would be well to take advantage of this principle. The variation of an inch decides the case, and as it so frequently happens to fall within the rails, it is probable, that when it falls without these bounds, the deviation at first is very trifling. Hence, if the front wheels of the engine were provided with three or more grooves each, capable of running on the rail, though not exactly in conformity with the directions of the tender wheels, they would be yet sufficiently so to hold the engine on the rails till the train stops. See C, fig. 2, which represents a section of the lower portion of such a wheel. The adoption of this plan would not imply any alteration of the general line of rails as at present laid; but at the switches and points there would necessarily be a different arrangement. At these places the rails must be made in halves, and solid, as at D, when the part leading to the intended new course must remain at its original level, and the other be depressed below the flanch of the wheel as at E. These actions may readily be so coupled by proper machinery, that the one could not take place without the other.

The necessary alterations in the construction of the points of switches to meet this arrangement, may render it necessary to adopt the double flanch, or groove form, in the front wheels of each carriage; in which case it may be well to give them also the advantage of the three grooves in preference to one only, for it frequently happens in accidents that several carriages in succession become the leaders of the train, by those in advance having broken away, and thus the remainder of the train may be preserved on the rail by these extra grooves.

I shall not trouble you or your readers with more on this subject at present; but

may perhaps, should accidents still further accumulate, endeavour to draw together once more, the various means that have been suggested for saving human life from these Juggernaut engines, and shall be glad to be favoured by such suggestions as others may in the mean time place in your valuable pages.

I am, Sir, your obedient servant,

George Cayley.

P.S. Query—could not a good buffer, the same as I have put in front of the engine, be added at the tail of the stoker's carriage? It would be a great advantage, and save many a life and limb, if it could, with convenience. The cover must be incombustible, as in that position it would be much exposed to sparks.

G. C.

Brompton, August 20, 1845.

THE LOCOMOTIVE AND ATMOSPHERIC SYSTEMS OF RAILWAY PROPULSION.

Sir,—There seems to be considerable doubt in the public mind relative to the comparative merits of the locomotive and atmospheric systems of railway propulsion. By first considering what constitute the chief features of a perfect railway system, we shall then be able readily to ascertain where their respective defects lie.

A road should require but little embanking, little cutting, and no tunnelling whatever; so as not only to enable the cost for formation to be small, but likewise to prevent the possibility of heavy land-slips. The propelling power should be great, and obtained at a moderate cost, and able to ascend with ease and speed steep inclines, and should be able to stop a train, either at will of the train guards, or at will of a person having a knowledge of its exact position and speed at every point of its journey; and there should be little or no waste of the propelling power, for all, or nearly so, should be absorbed in propelling a train. There should be no disagreeable noise, and not even a possibility of one train running against another, or getting off a line, owing either to sharp curves, or from any other cause; and lastly, great speed should be combined with perfect safety.

If we consider the foregoing as describing the chief features of a perfect railway system, it will be indisputable that the locomotive system is far, very far, from being perfect. That system compels us to construct a road by forming open cuttings through the lesser hills of earth and rock, tunnelling through those of greater height, and raising viaducts and embankments in valleys. For constructing that road, we have to pour out an immensity of money; and after it is formed, another large sum is wasted in repairing extensive slips in cuttings and embankments; and furthermore, the lives of passengers are endangered by those slips, and by the probability of a mass of rock or chalk falling from perpendicular cuttings upon the rails at night, and overturning a train; and again, our trains are compelled to travel through deep cuttings, over high embankments, and through dark dreary tunnels, thus infusing a degree of terror, especially among the female portion of passengers, which renders railway travelling very unpleasant to them. It is true there is but little danger in passing through even a long tunnel upon a well-regulated line, such as that at Kilsby; but who will say that passing through that or any other tunnel is not disagreeable to him, either on account of fear, the horrible din of the train, its dreary darkness, or the sulphurous smell of the smoke? That system compels us to pay for expensive engines and tenders to run with the trains, and to lay a line with heavier rails than mere passenger carriages would require; and to pay heavily for keeping in repair those engines, inasmuch as the rapidity of their motion induces great wear and tear, and great liability to disarrangement of their working parts; and we have to pay heavily for maintenance of way, principally owing to the great weight of locomotives, and their mode of obtaining a fulcrum upon the rails. We are at an extra outlay for fuel, because stationary condensing engines are much more economical to work than high-pressure locomotives, not only by using the cheaper material, coal, instead of coke; but because, in condensing engines, steam of a low temperature may be advantageously used; and that in all high-pressure locomotives, when travelling at great speed, the used steam upon one side of a piston cannot

escape sufficiently fast, thus neutralizing, to a very considerable extent, the propelling power of the steam upon the other side; and, furthermore, steam is wasted by slipping of the driving-wheels, the necessity of having a short stroke and short connecting-rod, and by having to propel a locomotive and its tender with each train. The amount of steam wasted by this latter circumstance will readily be understood by supposing that, out of a train weighing 60 tons, the locomotive and tender weigh 20 tons. It is indisputable that the mere propulsion of the locomotive and tender in this case will absorb one-third of the whole effective power of the engine. Should the weight of the trains be less, of course the loss will be proportionately greater; and lastly, the locomotive system is unsafe, whether a railway has a single or double set of rails; because, unless all those having the charge of locomotives are steady, discreet, and experienced men, the chances of collision between trains, or between an engine and train, are considerable, as the many accidents from collision fully testify.

From the preceding remarks, it is evident the locomotive system necessitates us to construct an expensive disagreeable road, and to pay heavily to keep it in good repair; the engines are noisy and expensive in their first cost, expensive to keep in repair, and comparatively very expensive to work; and, moreover the mode of working locomotive railways is attended with considerable danger from collision.

Thus, then, although every one must freely admit the locomotive system possesses many advantages over the old system of horse traction, yet it must as freely be allowed that system is but a very imperfect one.

The atmospheric railway system is unquestionably superior to the locomotive for short railways, having but one incline, and for level railways, so far as regards safety and economical working; but is unsuited where moderately steep inclines alternately ascend and descend between two termini, because the atmospheric propelling power acts while a train is descending an incline. The chances are, that while descending, what with its previous impetus, the impetus derived from its own weight, and the propelling power of the piston, the guards would be unable to control the train with their breaks. The consequence would then be, the acceleration of a train to a most dangerous velocity. It is true the atmospheric propelling power can be made to cease acting upon the piston while descending an incline, destroying the vacuum by allowing the outer air free access to the rarefied portion of the tube. This plan is decidedly objectionable, on account of the great loss of power and delay which would be occasioned, as a vacuum would have again to be produced, so that the piston might be propelled after the descent has been accomplished. Another plan is, that immediately upon commencing a descent, the engineman at the terminus is telegraphed to stop the engine; the onward progress of the piston partially destroys the vacuum in the tube, by gradually packing the air within. This plan is objectionable, because it merely slightly lessens the propelling power; and by packing the air within the tube, this latter will have again to be rarefied, and thus cause delay to the train. And lastly, the only other feasible plan is to prevent, by means of a valve in the hindmost of a double piston, the outer air getting access into that portion of the tube *behind* a train, thus causing the onward progress of the train partially to rarefy the air *behind*, and so lessen the amount of atmospheric propelling power; but this is manifestly a very imperfect plan, as it would not, in many cases, lessen the danger, and in others but slightly. In fact, there will always be danger unless the propelling power can be made entirely to cease acting at will. Your readers are doubtless aware that guards cannot apply breaks to the wheels of carriages travelling at high velocity without considerable danger, as a jumping motion is immediately given to those carriages, and they are very likely to jump off the rails in case they meet with a bad joint; and they have a tendency to be thrown off by the hind carriages bumping against and propelling them forward. It is thus obvious the power should not only be enabled to cease *propelling*, but should be capable of *resisting* the onward progress of a train at will.

The only material loss of power in the atmospheric system results from the outer air getting access into the interior

of the tube, thus counteracting the efforts of the air-pump to produce a vacuum. This leakage, we must be well aware, owing to the extreme subtlety and expansibility of air, must be very considerable, because it will be next to an impossibility to keep the whole of the valves and piston perfectly air-tight. Air rushes through an almost imperceptible opening into a rarefied space with extraordinary velocity, and takes but a short time to fill a vacuum. This fact necessitates the employment of very large engines to pump out air from the tube. The quicker this is done the better, as the outer air has less time to counteract the efforts of the engine. Other circumstances necessitate the employment of very large engines, which are these,—the loss of power arising from increased friction of the engine, and the amount of time occupied in rarefying the tube, which increases rapidly the nearer its interior approaches to a perfect vacuum. For example, if an engine requires to make 50 strokes to produce an unbalanced pressure of 5·6 lbs. upon every square inch of the piston's area, it will require another 50 strokes to produce a pressure of 9·1 lbs.; another 50 strokes, a pressure of 11·3 lbs.; and another 50 strokes—that is to say, 200 strokes in all—to produce an unbalanced pressure of 12·6 lbs. Consequently, if it takes 4 minutes to produce an unbalanced pressure of 9·1 lbs., 8 minutes will be consumed in causing that pressure to amount to 12·6 lbs. It is thus clearly manifest that an unbalanced pressure of 9·1 lbs. upon every square inch of the piston's area, may be obtained at half the cost of a pressure of 12·6 lbs.; but then, on the other hand, a pressure of 9·1 lbs. is so trifling, as to render necessary a large piston, and consequently a large tube, to obtain sufficient power to propel a train of even moderate weight, thus necessitating larger engines, and increased cost for increased size of the tube.

The chief defects of the atmospheric system are,—

1st. A road must be as level, or nearly so, as a locomotive line, thus rendering necessary expensive embankments, viaducts, cuttings, and tunnels, simply because the propelling power acts while a train is descending an incline, thus rendering a road possessing bad gradients unsafe.

2nd. The propelling power cannot control a train.

3rd. The great loss by leakage.

4th. The great first cost of machinery, owing to the necessity of having very large engines at every interval of about three miles, to rarefy a large tube quickly.

Your readers will thus see that, although the atmospheric system possesses considerable merit, yet great improvements will be required before it will even equal the locomotive system. Those improvements, I have no doubt, will, ere long, be made. My object in forwarding this paper to you is to show to those of your readers who are endeavouring to improve upon that system, that there are other and more necessary requirements than doing away with the continuous valve, or preventing loss of power by leakage.

I am, Sir,

Your obedient servant,

FREDERICK LIPSCOMBE.

93, Regent-street.

THE COMPUTATION OF DIRECT DISTANCES.

[Continued from p. 135.]

Sir,—I shall now proceed to make a few remarks on "A. B.'s" second problem, vol. xliii. page 4.

After a very long geometrical investigation he ultimately arrives at the final equation,—

$$\cos. b = \cos. B, \sin. a, \sin. c + \cos. a, \cos. c.$$

Now this takes up nearly three columns; but the proof might be made out in two or three lines from his first equation (vol. xlii. page 412,) viz.,—

$$\cos. B = \cos. b, \text{cosec.}\ a, \text{cosec.}\ c - \cot. a, \cot. c.$$

Now, $\text{cosec.}\ a = \dfrac{1}{\sin. a}$, $\text{cosec.}\ c = \dfrac{1}{\sin. c}$; also, $\cot. a = \dfrac{\cos. a}{\sin. a}$, and $\cot. c = \dfrac{\cos. c}{\sin. c}$.

Hence, $\cos. B = \dfrac{\cos. b - \cos. a, \cos. c}{\sin. a, \sin. b}$

$\therefore \cos. = \cos. B, \sin. a, \sin. c + \cos. a, \cos. c.$

Hence, &c., Q. E. D.

It is evident that this equation of "A. B." is not at all fitted for logarithmic calculation, requiring, as in the first case, three sets of tables—and, according to his own showing, four distinct cases—to determine whether the required side be acute or obtuse. I here beg to inform the tyro in spherical trigonometry, that all that is required to be geometrically demonstrated is this fundamental equation, $\cos. A = \frac{\cos. a - \cos. b, \cos. c}{\sin. b, \sin. c}$; from which it follows that—

$$\cos. B = \frac{\cos. b - \cos. a, \cos. c}{\sin. a, \sin. c},$$

and $\cos. C = \frac{\cos. c - \cos. a, \cos. b}{\sin. a, \sin. b}$; where A, B, and C are the three angles, and a b c the opposite sides. No farther aid is required from geometry, all the cases being made out by the analytieal method, the analyst taking care that his theorems are well adapted (when it is possible) for logarithmic calculation. The inventor of the logarithms, the illustrious Napier, has shown how this is to be done. Indeed, little has been discovered on this subject since his time. It may, however, be stated, that the application of versed sines may be sometimes applied with good effect. Thus, by solving "A. B.'s" fourth question by this method, we have

$$\text{ver. sin. } b = \text{ver. sin. } (a-c) + \sin. a, \sin. c, \text{ ver. sin. B.}$$

Here $a = 112° \ 54' \ 42''$, $b = 77° \ 27'$; $\therefore a - c = 35° \ 27' \ 42''$, and $B = 96° \ 48'$.

Solution.

$a = 112° \ 54' \ 42''$	sin.	9·964310	
$c = \ 77° \ 27' \ 0''$	sin.	9·989497	
$B = \ 96° \ 48' \ 0''$	ver. sin.	10·046772	
	Log.	0·000579	
	Nat. Num.	1·00134	
$a - c = 35° \ 27' \ 42''$	ver. sin.	·18550	
		1·18684	ver. $b = 100° \ 46' \ 16''$.

The above method is much shorter than that of "A. B.," and confined to one case; for when the ver. sin. of b is greater than 1, the arc is obtuse; when otherwise, acute, although three tables are required.

The following method is new, I believe. I shall only here give the rule and calculation, leaving the demonstration to any of your able contributors.

Rule.—Assume $\frac{a+c}{2} = s$, then find θ such that

$$\cos. \theta = \sqrt{\frac{\sin. a, \sin. c \cos. ^2\frac{B}{2}}{\sin.^2 s}};$$

then $\sin. \theta, \sin. s = \sin. \frac{b}{2}$.

Calculation.

$a = 112° \ 54' \ 42''$	$\frac{\text{log. sin.}}{2}$	$= 4·982155$
$c = \ 77° \ 27' \ 0''$	$\frac{\text{log. sin.}}{2}$	$= 4·994748$
$\frac{B}{2} = \ 48° \ 16' \ 0''$	cos.	9·823255
		19·800158
$s = \ 95° \ 10' \ 21''$	sin.	9·998222
$\theta = \ 50° \ 40' \ 15''$	cos.	9·801936
	sin.	9·888470
(log. θ + log. s) log. sin. $\frac{b}{2}$ $50° \ 23' \ 9''$		9·886692

$\therefore \ b = 100° \ 46' \ 18''$.

Hence $b = 100° 46' 18''$, the time as before, nearly.

The above appears longer than the first; but it requires only one set of tables, and is, on that account, really sooner done.

KINCLAVEN.

DESCRIPTION OF THE GREAT BRITAIN IRON STEAM SHIP, WITH SCREW PROPELLER; WITH AN ACCOUNT OF THE TRIAL VOYAGES, BY THOMAS RICHARD GUPPY, ESQ. C.E.

[From the Proceedings of the Institution of Civil Engineers.]

The Great Western Steam Ship Company originated with a few directors and proprietors in the Great Western Railway Company, who entertained the idea, that, on the completion of the railway from London to Bristol, a direct line of communication, by means of steam-boats, to New York, as the focal point of the New World, might be established with advantage.

Hitherto, attention had been directed to the south-western harbours of Ireland, and the nearest ports in America, as the extreme distance between which steam-boats of the great power then supposed to be practicable, would be enabled to carry a sufficient quantity of coal for the voyage; but this company, placing confidence in the opinion of Mr. I. K. Brunel (their engineer), ventured to build the *Great Western*, a steamer exceeding in size any that had previously been constructed, and with engines of so much greater power, that the predictions of many experienced and scientific men were unfavourable to the project.

The *Great Western* did, however, fulfil the expectations entertained of her by her projectors, in all respects, except in that, like many other moderate-sized steam vessels, so large a part was occupied by the machinery, relatively to that which could be appropriated to passengers and goods, the deficiency of space was soon found to operate disadvantageously in a pecuniary point of view.

At first it was intended that their second ship should be of timber, but the superior advantage which the introduction of iron appeared to hold out, induced a very careful comparison, and an investigation into the state of some small steam vessels already constructed of this material, and the result was the abandonment of the previous resolution.

As no example of an iron steam ship of sufficient size existed, on which to base any calculation of the thickness of the iron to be employed in its construction, or of the disposition of the material, in order to obtain the greatest relative degree of strength, much consideration was requisite, and it became necessary to organize an establishment for building iron instead of wooden ships, before the keel of the new vessel was laid.

The principal dimensions of the hull of the *Great Britain*, are—

	Ft.	In.
Length of keel	289	0
Length aloft	322	0
Main breadth	50	6
Depth of hold	32	6

The tonnage, according to the usual mode of builder's measurement, is therefore, 3,444 tons.

The weight of iron used in the hull is about 1040 tons; which is equal to an average thickness of 2¼ inches.

The weight of the wood-work in the decks, fittings, &c., is about 370 tons.

And the weight of the engines and boilers (exclusive of the water) is 520 tons.

The total weight, therefore, is 1,930 tons; which, at a draft of water of 10 feet 6 inches forward, and 13 feet 7 inches aft, corresponds exactly with the calculation of the displacement of the hull, which is as follows:—

Draft.	Fore Body.	AfterBody.	Total.
Feet.	Tons.	Tons.	Tons.
12	1053	851	1904
14	1315	1099	2414
16	1594	1386	2980
18	1904	1714	3618

She will therefore be able to take 1000 tons of coal, and 1000 tons of measurement goods, weighing perhaps 400 tons, at a draft of 17 feet forward, and 17 feet 6 inches aft.

The keel plate consists of plates ⅞ths of an inch in thickness, by 20 inches wide, which were welded into lengths of 50 feet to 60 feet, and these lengths were joined together, by very accurately made scarphs, 1 foot 6 inches in length, and riveted all over, at distances of 4½ inches apart.

The end pieces of the keel, which are more liable to touch the ground, are full 1 inch in thickness.

The stem is 12 inches deep at the forefoot, by 5 inches thick, and at the 8 feet water mark, it is 16 inches by 2½ inches; thence it diminishes gradually to 12 inches by 1½ inch. It is welded in one piece 18 feet long.

The ribs or frame are formed principally of angle iron, 6 inches by 3½ inches by ⅝ths

inch, at distances of 18 inches from centre to centre, but inclining gradually to 24 inches at the extremities, where, also, angle iron, 6 inches by $2\frac{1}{2}$ inches, and 4 inches by 3 inches is used.

In that part of the body of the ship which is occupied by the engines, the ribs are doubled, by having a similar angle iron riveted to them, with the web inside, or, as it is termed, "reversed."

The outside plating commences with plates 6 feet to 6 feet 6 inches long, and 3 feet wide, by $\frac{11}{16}$nths inch thick; of these plates there are four courses; these are followed by several courses of $\frac{5}{8}$ths inch thick, which is the strength of the whole of the immersed part, up to the deep load water line.

Above that height the same thickness is preserved amidships, but it is gradually reduced to $\frac{3}{8}$ths inch thick quite high up, and at the extremities, with a view to lighten them.

The longitudinal floor sleepers are ten in number; they are 3 feet 3 inches in depth, and $\frac{1}{2}$ inch and $\frac{7}{16}$nths inch thick.

The middle sleepers extend throughout the length of the vessel; those on the sides are level on their upper surface, and consequently are terminated by the rising of the bottom of the ship.

These sleepers are tied to the bottom, and are preserved in their vertical position by inverted curves of strong angle iron, which are riveted to the ribs and also up their sides.

Along the upper edge of each, there is an angle iron, and over the whole is riveted an iron deck $\frac{3}{8}$ths inch in thickness.

There are two bilge keels, consisting of a middle plate, $1\frac{1}{4}$ inch thick, and two angle irons, 5 inches each way by 1 inch thick.

These bilge keels are 110 feet long, and their under edges are on the same horizontal level with the under side of the keel, so that in docking the ship, if long baulks of timber are extended across the dock by way of blocks, the weight of the body of the ship (where the boilers and machinery are placed), is supported at given parallel distances on both sides of the keel, all risk of straining it, or the machinery, is avoided, and the vessel is not obliged, in the usual manner, to rest upon her keel, until the bilge shores can be got under.

The upper cargo deck forward is made of plate iron, $\frac{5}{16}$nths inch thick in the middle, and $\frac{9}{16}$nths inch thick round the sides; it is riveted together throughout, as well as to the iron deck beams, and to the sides of the vessel.

The main deck is made of pine timber 5 inches thick, and the planks are cross-bolted at distances of 4 feet apart.

As this deck is situated on the load floatation plane of the vessel, where transverse stiffness is of more importance than longitudinal strength, the planks are placed athwartships, and their extremities are firmly bolted down, through two longitudinal stringers of Baltic timber, to the shelf plates, which are 3 feet wide by five-eights of an inch thick, and are very securely fixed to the sides.

The middle or promenade deck is also of pine timber 4 inches thick, placed lengthwise of the ship; it has also strong iron shelf-plates 3 feet wide by $\frac{1}{2}$ inch thick, and Baltic stringers to attach it to the sides of the ship.

The upper deck is of red pine timber, and is also placed lengthwise. As the sides of the vessel at this height, and also this deck, may be considered as the truss, which is to resist longitudinal deflection, or drooping of the extremities, the outside plates are there $\frac{1}{2}$ inch thick, and they have been strengthened by an outside moulding-iron strap, 6 inches by 1 inch, and by additional straps of iron 7 inches by 1 inch, welded into lengths of 60 feet, and riveted to the inner sides of the upper line of plates.

The shelf-plate of the deck is 3 feet wide by $\frac{1}{2}$ inch thick, and upon this, outside of the water-way plank, which is $4\frac{1}{2}$ inches thick, there is a course or tie of Baltic pine timber 340 inches in section, carefully scarphed and securely bolted to the ribs, and to the shelf-plate, throughout the length of the ship. There are three rows of timber pillars, or staunchеons, which are fixed to the bottom of the ship, passing up between longitudinal ties at each deck, and are secured to the upper one.

The beams of all these decks are made of angle iron, 6 inches by $3\frac{1}{2}$ inches by $\frac{1}{2}$ inch, and their ends are bent down, and riveted to the ribs on each side.

Upon them, the shelf-plates before mentioned are riveted, and thus form a horizontal band 3 feet wide at each deck.

A crutch or strut is introduced at each end of nearly every deck beam, which is riveted to it, and to the ribs at about 3 feet from the angle of junction.

One of the most important improvements which has recently been introduced in the construction of vessels (particularly those of iron), is the water-tight bulkhead; as in the greater number of cases, when an injury may be sustained in one compartment only, it may absolutely preserve a vessel from sinking; several instances of this have already occurred, and even where it may not suffice for this purpose, it at least separates the leaky and injured from the secure parts,

and gives time either to attempt to stop the leak, or to make other preparations.

In iron vessels, these bulkheads can be rendered much more effectual than in wooden ones, by their exact contact with the bottom and sides, while at the same time they form admirable ties and stiffeners.

In the *Great Britain* there are five such bulkheads.

The first separates the forecastle from the forward passengers' cabin and the hold, and as it is in the forepart of a vessel that injury is most likely to be sustained, this partition is made particularly strong and secure.

The next bulkhead divides the forward cabin from the engine-room or more properly, from the fore-hold for the coal and the stokers, at the forward end of the boilers.

The third bulkhead is abaft the engine-room, but in this, there is necessarily a hole for the screw-shaft to pass through; this is secured by a well-fitted collar, and there is also a door, which is so arranged as to be shut and bolted quickly.

These three bulkheads pass up to the upper deck; there are also two others; one separating the after coal-hold from the after cargo-hold, and another nearly at the stern; both these terminate under the saloon deck.

The minute detail of the construction of the hull of the vessel would be too voluminous to be given here, and it would be unnecessary, as it will shortly be published.* It is better, therefore, to proceed to describe the action of the screw propeller, which has now become an object of such deep interest to all who are engaged in marine engineering, and to the machinery by which it is to be put in motion.

At an early stage in the construction of the *Great Britain*, but not until her sides had assumed the form adapted for paddle wheels, the small steamer *Archimedes*, belonging to the Company owning the patent of Mr. F. P. Smith for the application of the Archimedean screw, visited Bristol, and amongst other parties invited to make an excursion to the Holmes, on board of her, were some of the Directors of the Great Western Steam-ship Company.

The performance of the screw on that occasion induced the author to request permission of Mr. Smith and Captain E. Chappell, R.N., who was officially appointed by the Admiralty to report upon her, to proceed in her to Liverpool.

On the passage, enough rough weather was encountered, to show that the screw possessed several good points, and was not so absolutely impracticable as had been asserted; and although far from venturing to give a decided opinion, on the author's return he wrote such a letter to the Board of Directors as induced them, after some days of deliberation, to decide upon suspending, during three months, the progress of the machinery for paddles, and also of that part of the vessel which might be affected by the change, and to call upon Mr. Brunel during that period to investigate the subject.

At the end of the proposed delay, the report which Mr. Brunel made was so favourable, that, undaunted by the novelty and vastness of the experiment, the Directors resolved to adopt this mode of propulsion, of the success of which they have now such cause of congratulation.

From that period, until it became necessary to decide on the exact form of screw to be used, all possible means were taken, by experiment and observation, to arrive at the best shape and angle of inclination of the blades, or as it is commonly called "the pitch."

Amongst others, the proprietors of Mr. Smith's patent liberally lent the *Archimedes* to the Great Western Steam-ship Company, for a period of several months, which afforded ample opportunity of trying the performances of the several forms of screws recorded in the Table given in the next page.

These experiments were made in the Bristol Channel under circumstances of weather, as nearly as possible similar, and the distances were very carefully measured by two of Massey's Logs, whose accuracy had been previously tested.

It will be observed, that the greatest velocity of vessel, 8·375 knots, was attained by Mr. Smith's screw of 5 feet 9 inches diameter, the angle of which was 19¾ degrees, and the slip was 21 per cent.; that is, the ratio of speed of the vessel to that of the screw, was as ·787 to 1.

Particular attention is due to experiments Nos. 5, 6, and 7.

Reasoning upon the assumption, that the effort of the entering edge of each blade must cause the water to recede, and that each succeeding portion of blade should so increase in pitch as to impinge with uniform force against the water, which was so receding, a screw of this description was made and tried before it was discovered that it was the subject of a patent by Mr. Woodcroft.

The first trial served to show, that the curvature or increase of pitch which had been given to it was too great, since the speed of the vessel was greater by 2 per cent. than that due to the mean pitch of the screw, whence it was evident that the entering edge was really retarding, and the terminating portion alone was doing the duty.

* In four Parts, large quarto, with forty plates, by Weale, 59, High Holborn.

Number of Experiment.	Strokes of Engines per Minute.	Horse Power by Indicator.	Speed of Vessel in Knots.	Speed of Screw in Knots.	Ratio of Speed of Vessel to 1· of Screw.		Diameter of Screw.		Pitch.	
							Ft.	In.	Ft.	In.
1	25·41	67·1	8·375	10·646	·787	Smith's two half threads, made of wrought iron.	5	9	8	0
2	20·75	53·7	8·16	10·88	·75	Ditto, ditto . .	5	9	10	0
3	26·25	63·59	7·55	8·23	·917	Ditto, made of cast iron . .	7	0	6	0
4	20·5	57·13	7·42	8·52	·87	Ditto, ditto . .	7	0	8	0
5	20·	57·3	8·175	8·	1·02	Woodcroft's increasing pitch, 3 blades, made of cast iron, as first made.	7	0	7	7½
6	21·5	62·6	8·1	8·1	1·	The same, with 3 inches cut off the termination of the blades.	7	0	7	2½
7	22·5	62·12	8·2	8·73	·94	The same, with 4 inches cut off the entering edge of the blades.	7	0	7	5
8	20·5	51·4	7·49	8·566	··	Four wrought iron arms, with blades, each 2 feet 9 inches long by 1 foot broad.	7	0	8	0

On the second trial, when a radial strip 3 inches in width had been cut off the after part of each blade, the speed of the vessel was exactly that due to the screw; whence it was also evident, that the front edge still did not assist.

On the third trial, after a second radial slip of 4 inches had been cut off the entering edge of each blade, the vessel attained a speed of 8·2 knots, and the ratio of speed of the vessel was as ·94 to 1 of the screw.

The horse-power employed on this trial, was by indicator, 62·12, and the speed of the vessel 8·2 knots, against 67·1 in the before-named trial, with the original screw of the *Archimedes*, when the speed she attained was 8·375 knots.

Although on neither of the trials numbered 5, 6, and 7 with this screw, was so great a speed of vessel attained as on that first named, it is important to draw attention to the fact, that the slip was reduced to a very small quantity.

But the horse-power exerted was also much less than in the first trial, arising from some imperfections in the cutting down of the screw and other causes, which would probably have been remedied had there been time to cast a new screw of this description; but unfortunately, just at this period, the Propeller Company required the *Archimedes* for service, and the experiments ceased.

This screw was afterwards tried by Mr. Barnes in the *Napoléon*, a very beautiful French Post-Office vessel, built by M. Normand, of Havre, when the following result was obtained:—

Horse Power exerted.	Speed of Vessel in Knots.	Speed of Screw.	Speed of Vessel to 1· of Screw.
95·5	10·15	11·2	·895 = 10½ per cent.

In the two cuttings down, this cast-iron screw with three blades, 9 feet in diameter, which was originally very slight, had been so much reduced in substance, that it weighed only 833 lbs. Mr. Barnes, therefore, could not venture to permit the engines to exert their full power, otherwise it is probable that a higher speed would have been attained.

The commencing angle is 17°, and the terminating one 19½°; the increase of pitch is therefore $\frac{1}{12}$th, or 8⅓ per cent.

The screw of the *Great Britain*, which is of wrought-iron, consists of six arms, formed by placing and riveting together four distinct forgings, or centre pieces, with arms welded to them, each of which is 6 inches thick.

Upon the extremities of these are riveted palms of plate iron, which are 4 feet 4½ inches long on their circumferential edge, by 2 feet 9 inches in height, and ⅞ inch thick.

The diameter is 15 feet 6 inches, and the pitch or helix of one revolution is 25 feet, which equals an angle of 28 degrees.

Its weight is 77 cwt.

The area of the six palms, which may be considered as the effective part of the screw, is 56·25 feet; but the area, calculated as a plane perpendicular to the axis, that is, as portions of a disc, is only 47·4 feet, and the portions of the arms within the blades, present a similar area of 26·88 feet.

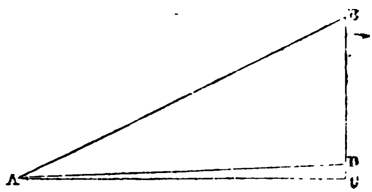
As the rotary velocity of the outer edge of the blades is nearly 30 miles an hour, it is important, in order to diminish friction, that they should be as accurately shaped as possible, and should present no irregularities of surface. In this instance, the object was attained, by mounting the screw on a face plate and planing the surface, by means of a tool, to which the proper motion was given; after which it was painted several times, rubbed very smooth, and varnished.

On the second trial of the *Great Britain*, on the 20th January, in the Bristol Channel, in smooth water and during a calm, the engines attained the speed of 18¾ strokes per minute, when the speed of the vessel through the water, measured by an experienced seaman, with the common log, was 12¼ knots.

$$
\begin{array}{ll}
18{\cdot}66 \times 2{\cdot}948 \times 25 = 1375{\cdot}242 & \text{feet, velocity of the screw.} \\
12\tfrac{1}{4}\text{knots} \times 101{\cdot}2 \quad = 1247{\cdot}796 & \\
\hline
\quad\quad\quad\quad\quad 127{\cdot}446 & \text{slip,—}
\end{array}
$$

thus, the speed of the vessel was ·907 to 1· of the screw.

The area of the midship section of the ship, at the time of this experiment, was 480 feet.



The annexed diagram is intended to illustrate this effect thus:—

The angle subtended by A, B, C, is an entire revolution of a screw 15 feet 6 inches diameter and 25 feet pitch, of which B D is the forward effort communicated to the vessel, and C D is the slip, or yielding of the water. Consequently, although the apparent angle of the screw is represented by A B C, the real angle is only A C D, since A B D represents the velocity of the vessel.

(*To be continued.*)

ELECTRO-CHEMICAL TREATMENT OF COPPER ORES.

Messrs. Berthier Dumas and Becquerel have made a report to the French Academy of Sciences, on a communication made to that body by Messrs. Claubry and Dechaud, from which it would appear, that the latter had, long before the date of Mr. Wall's patent in this country, (see *Mech. Mag.*, vols. xli. 105; xlii. 443,) successfully applied electricity to the separation of metals.

The Reporters state that, nine years ago, Messrs. Claubry and Dechaud announced to the Academy that they had succeeded, by the means of a very simple electro-chemico process, to extract gold, copper, and lead from their respective ores.

First of all, this process requires the transformation of the ore into a soluble composition or liquid, which is easy to be obtained in the place of working, as it is only in these cases that electric force can act to separate the metal from its combinations. If it is copper ore, such as the carbonate, the oxide, sulphur, or double sulphur, which are the most common, they transform them into sulphate, the two first with sulphuric acid; and the two latter in roasting them—an operation which is performed to great advantage in Mexico, by the preparation of the *magistral*, an indispensable agent in the amalgamation in patio. When once the sulphuration has taken place, the ore is washed, and the solution is submitted to the electro-chemical decomposition in a very simple apparatus. If they wish to obtain the copper in blades, or sheets, the apparatus must be so arranged, that the solution may always be at its maximum of saturation. Messrs. Gaultier de Claubry and Dechaud have succeeded in performing this by the most simple means, as follows:—When they place in a vase two solutions, the one saturated with strong sulphate of copper, the other sulphate of iron, not so strongly impregnated; if in the first one, they place a sheet of copper, in the other a blade of cast metal—communicating with the first one by means of a metallic conductor, there will be obtained a voltaic couple—the action of which is sufficient to decompose the sulphate of copper; the oxygen and the sulphuric acid operate on the cast metal, from which results the sulphate of iron, whilst the copper deposits itself, or adheres to the

sheet of copper—forming the negative pole. The copper deposited at first is in the purest chemical state, but the iron becoming more and more abundant, the copper, in precipitating, carries with it iron; it becomes by degrees fragile, afterwards pulverulent, or powder, according as the solution becomes weakened. Whilst this solution decreases in density, that of the sulphate of iron, on the contrary, increases in density; the result is,—1, a solution of the normal copper, which occupied the lower part of the vase; 2, a solution of the same salt, less dense, and swimming on the first; 3, a solution of sulphate of iron, very dense; 4, another normal solution. To remain in its primitive state, and to obtain the copper in leaves, it was necessary to take off the solution of sulphate of copper less dense, and that of the sulphate of iron more dense; it is in this consists the principal improvement of the treating of the electro-chemical process of copper ores by the above-named scientific gentlemen.

Their apparatus is constructed in the following manner: A wooden case is lined with lead, and covered afterwards with wax, or any other greasy substance, so as to receive the solution of the sulphate of iron. This case is provided with two apertures; the one above for the introduction of the normal liquor; the lower one serving to expel the dense liquor by means of syphons or cocks. In the interior, at suitable distances, are placed the boxes, in copper or cast-iron, lined with lead, of which the extremities, or the lower part, is in metal, whilst the outer part is open, and covered with a strong sheeting of pasteboard. An underneath opening leads also by the means of syphons to the concentrated solution of copper, and another one placed nearly on the upper part, permits the running off the weaker solution. In these cases are placed the neutral metal destined to receive the deposit of copper, and between each of them, as well as in the exterior of the two outward cases, are the cast plates that are to produce the voltaic action. Metallic conductors are used to establish the communication between the double parts; and the apparatus is so arranged that at each time there arrives as much of the strong solution of the sulphate of copper as the weak solution of iron, so that the action continues without any great labour. When once the apparatus is got up, it only requires that the leaves of copper should be taken off when they are thick enough, and to replace the metallic plates when they have been dissolved, The running of the liquid is operated by means of the syphons as regards the flowing the basin, and it is of very little consequence what the cast metal may be, as the worst sort is equally useful. The leaves of copper can be sent immediately to market; and, if passed through the flattening machine, they become equally as hard as the generality of copper that has undergone that process. All the copper that is precipitated is not obtained in leaves or sheets, as there is only about three-fifths, and not even the half; the remainder is in a pulverised state, or fragments, that undergo melting. The electro-chemical process for treating of copper ores by the improved method of Messrs. Gaultier de Claubry and Dechaud appears to present great advantages over the former methods; but it is requisite that these ores should be transformed entirely, and that at a low expense, into sulphates, as the main point is there. If these facilities can be obtained, there is very little doubt of the successful issue of the method.

IMPORTANT CASE OF INFRINGEMENT OF PATENT.

Liverpool Summer Assizes, Aug. 26 *and* 27. *Before Mr. Baron Rolfe, and a Special Jury. Newton* v. *the Grand Junction Railway Company.*

This was an action to recover compensation from the company for the alleged infringement of a patent taken out by the plaintiff on the 15th of May, 1843, for improvement in the bearings of the axles of railway carriages, and other axles where great friction existed. The invention purported to have been a communication from a Mr. Isaac Babbelt, an American, from Boston. Mr. Babbelt was in Liverpool in the year 1843, and had permission from the Liverpool and Manchester Railway Company to make experiments on two of the engines on their line. The result was satisfactory, and he afterwards sold the discovery to the present plaintiff.

A great mass of evidence was adduced, to show the nature of the invention, its novelty and the importance of the results in diminishing the wear and tear of locomotive engines. It appeared that the invention consisted in lining the semicircular brass "step" of the axle, which rested on the axle, and bore the weight of the carriage, with an alloy of softer metal, of considerable thickness, which was prevented from spreading and yielding to the pressure by a brass fillet along its edge. The step was lined by first polishing the inside, tinning it, and then placing within it a mould the size of the axle or "journal," as it was called, running in the alloy while in a state of fusion. This alloy in cooling adhered to the tin and became incorporated with the brass step, fitting closely to the journal or axle which revolved in it.

A great number of witnesses were called to prove the advantage of this arrangement, in diminishing friction, in preventing the heating of the axles, in needing a smaller supply of oil, and in enabling the bearing to run for a much longer time without the necessity of renewal or repair.

Mr. Fothergill, foreman to Messrs. Sharp and Co., stated that he had for many years been employed in the manufacture of railway carriages, and that this improvement was new to him until the appearance of the patent in 1843. It was a very great improvement, and extremely useful in diminishing friction and preventing heating.

On cross-examination he stated that he had previous to that time known tin and lead used to repair old brasses when they had ceased to fit from wear, and there was not time to substitute a new one. The lead or tin was run in to make it fit until a new one could be supplied. He had known various bearings of solid block tin used, but they did not answer.

Mr. Robert Stephenson, C. E., gave similar evidence as to the utility of the invention. He said if the inside of the bearing were merely tinned, it would prevent heating, and in that thin coating would not spread by pressure. It would wear out sooner, and the fillet in the plaintiff's invention was useful in enabling them to run in a mass of alloy in a melted state, which coated the step to a considerable thickness without spreading by pressure, as it would do without the fillet.

Mr. John Fairburn, engineer at Manchester, gave similar statements as to the utility and novelty of the invention. He stated that he had known block tin and various alloys used for bearings, but always in a solid block. The novelty was in having an outer case and running in the alloy.

Mr. Thomas Wilkinson, foreman to Messrs. Bolton and Watts, Soho works; Mr. Jones, Clerk to the Liverpool and Manchester Company, near Newton, and others, were examined. Their evidence was to the same effect.

Mr. Michael Allison, out-door foreman of the locomotive department to the Liverpool and Manchester Railway Company, stated, that there had been a very great and marked improvement in the running of the engines since the introduction of this invention. The Kingfisher, the Heron, and the Ostrich were fitted up with these bearings. Formerly the brass bearings on the old construction would run from 400 to 1,000 miles. They would run, when fitted up pursuant to the patent, from 4,000 to 10,000. The Kingfisher had run 20,000, and the bearings were still in good condition. A bearing now produced had run 32,000 miles without repairs.

Mr. Benjamin Lewis, Mr. Edward M'Connell, engineer to the Birmingham and Glocester Railway Company; Mr. Benjamin Cubitt; Mr. Fernyhough, manager on the Eastern Counties line; Mr. Melling, engine-maker, at Rainhill, and others, repeated in a great measure what had been said by the other witnesses as to the novelty and the utility of the invention.

Evidence of the infringement of the patent was also adduced. It appeared that in the case of many of the old brass bearings, as well as in new ones, when put in for the first time, the workmen were in the habit of tinning the inside of the brass, heating it and then rubbing a stick of tin on it so as to cause it as much as possible to adhere. This had been pointed out to the directors on several occasions by their managers, and the results in preventing friction, and diminishing the expenditure of oil, were mentioned. A long correspondence between the plaintiff and the secretary of the company was put in and read, the plaintiff claiming compensation from the company for the use of his patent. In one of these letters the secretary, while he denied that the company was infringing the patent, added, that the use of the tinning, in the way described, was of very little benefit, and that they thought of abandoning it.

Mr. Wortley addressed the jury for the defence, and called a number of persons to show that at Nantwich, Bury, and other places, where the brasses used in cotton mills had become worn, or did not fit, it was very usual to run in a quantity of an alloy of tin.

Mr. Hodge stated, that many years before the existence of this patent, in 1829, he had made a lathe, being then resident in Cornwall, the bearings of which were provided with a fillet and lined with an alloy run in precisely in the manner decribed in the patent, the object being that which the patent proposed—the diminution of friction. There were then many bearings of the same kind in use in Cornwall. This lathe he afterwards took to London, and sold there. He had not heard of it since, and did not know that this improvement was then generally known. He afterwards made an experiment with a view to improved bearings for the axles of a saw-mill. The improvement was the making of three longitudinal grooves along the surface of the brass bearing, and filling them up with an alloy. Nothing further, however, was done in the matter. The witness afterwards went to America, from which country he had but lately returned.

Mr. BAINES replied, commenting strongly on the conduct of the company through their officers, who, he contended, had sought to evade the plaintiff's patent, and to get the benefit of his discovery without paying him that reasonable remuneration to which he was entitled.

His LORDSHIP summed up. He said the question for the jury would be whether the defendants had violated the plaintiff's patent by using the whole or any part of his invention. If a patent is granted for a new combination of things known before, that does not prevent any other party from using that which was old. There was no evidence that the defendants had used the whole of the plaintiff's invention in the steps with the fillets as described in the patent; but it seemed established that their servants took old and new brasses, and after tinning them in the usual way, had while the brasses were hot, with a stick of tin, laid on as much as they could to the extent of from the 16th to the 8th of an inch. Many of these brasses were new, and it was not, therefore, the mere patching of old ones. Was that substantially an adoption of any part of the patent—had they, by thus laying on the tin, smoothing it in some cases with a soldering-iron, as described, obtained some portion of the benefit of the invention; and was that part new?

The jury, after being out a considerable time, returned a verdict for the plaintiff—Damages, 1000*l*.

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC., CAP. 65. FROM JULY 24 TO AUGUST 23, 1845.

Date of Registration.	No. in the Register.	Proprietors' Names.	Address.	Subject of Design.
July 24	505	Henry Putland, and Charles Woods	60, Crown-street, Finsbury	Shaft tug.
,,	506	Edward Smith	8, Avery-row, New Bond-street.	Archimedean roller for window-blinds, maps, &c.
31	507	William Leschallas	32, Budge-row	Envelope fermée.
Aug. 1	508	John Hopkins	18, Brand-street, Greenwich	Chimney-pot and ventilator.
5	509	Thos. Beaney	Saint Leonard's, Sussex	Spring for carriages.
7	510	Elizabeth Furtardo	51, Wigmore-street, Cavendish-square	Symmetrical bodice.
9	511	Richard Lynex	35, Legge-street, Birmingham	Chain for lamps, and other purposes.
12	512	William Wharton	Foreman of the London and Birmingham railway, Euston station, London	Lubricating shields for journals.
,,	513	George Lee	45, Burgess-street, Sheffield	Improved form of handle for table knives and forks, to be called Prince Edward's pattern.
13	514	S. Mordan and Co.	22, City-road, Finsbury, London.	New revolving-top patent ever-pointed pencil.
,,	515	Donald Grant	Southampton-street, Strand	Ventilating double-chimney gas lamp, or chandelier.
14	516	Samuel Brittall & Co.	Lancaster-street, Birmingham	Defiance sash fastener.
,,	517	Edward Collins	Moland-street, Birmingham	Improved spindle and guide for twin button locks, &c.
,,	518	Rock, Brothers, and Payne	11, Walbrook, London	Improved letter clip.
15	519	Joseph Richards	Beverley iron works, Beverley, Yorkshire	Heating furnace.
,,	520	F. Butler	41, Sussex-street, London University, London	Fire-escape.
,,	521	William Gore Pearce, and Isaac Simmons Couran	2, Edwin-place, Peckham New Town	The newly-invented letter-box.
18	522	W. Chesterman	Wraxhall, near Bristol	Portable steam cooking apparatus.
21	523	Josh. Bunnett	26, Lombard-street, London	Railway signal.
22	524	Wm. Rimell	King-street, Hammersmith	Quick-boiling tea-kettle.
23	525	George Henry Faulkner	Falcon works, Manchester	Expanding boring tool.

NEW WORKS CONNECTED WITH THE ARTS AND SCIENCES PUBLISHED IN AUGUST, 1845.

A HAND-BOOK for Mapping, Engineering, and Architectural Drawing. By B. P. Wilme, C.E., M.R.I.A. 1*l*. 14*s*.

MANUAL of AGRICULTURAL ANALYSIS. By John Mitchell, M.C.S.L. Describing the apparatus used, the best methods of obtaining accurate results, the re-agents requisite, their purity and preparation; the classification, composition, and physical properties of soils, with an Appendix, containing results of experiments with manures. Illustrated with numereus woodcuts and tables. 4*s*.

The PRINCIPLES and PRACTICE of ART: treating of Beauty of Form, Imitation, Composition, Light and Shade, Effect and Colour. By J. D. Harding, Author of "Elementary Art." With numerous illustrations, drawn and engraved by the author. 3*l*. 3*s*.

A TREATISE on ARITHMETIC, for the Use of Schools, and of such persons as have not attained a competent knowledge of Numerical Calculations. By Thomas Exley, A.M. 2*s*. 6*d*.

PLANE TRIGONOMETRY and MENSURATION, for the use of the Royal Military College, Sandhurst. By William Scott, M.A., F.R.S., Professor of Mathematics in the Institution. 9*s*. 6*d*.

BRITISH MANUFACTURES. By George Dodd. (Knight's Weekly Volume.) Marble and Stone—Glass — Carpet — Floor-cloth — Pianoforte—Watch and Clock—Cabinet Manufactures. 1*s*.

LOCOMOTION, without Tunnels, Bridges, Steam, Rails, and the possibility of accident, with five drawings (including a horizontal windmill of almost unlimited power), and reflections on the absurdity of the principle on which locomotives are based. This work will excite a million times more interest than the electrical telegraph; for the economy of the system, which is founded on true philosophical principles, exceeds all belief. By Thomas Parkin, C.E. 1*s*. 6*d*.

MANUAL of ASTRONOMY: a Popular Treatise on Theoretical, Descriptive, and Practical Astronomy; with a familiar explanation of Astronomical Instruments, and the best methods of using them. Illustrated by upwards of 60 drawings on wood and steel. By John Drew, author of "Chronological Charts, illustrative of Ancient History and Geography." 7*s*. 6*d*.

LIST OF ENGLISH PATENTS GRANTED BETWEEN JULY 25, AND AUGUST 21, 1845.

William Breynton, of the Inner Temple, esq., for certain improvements in rotary steam engines. July 25; six months.

Alexander Wilson, of Glasgow, manager for Alexander Fletcher and Co., of the same place, spinners, for improvements in spinning hemp and flax, and other fibrous materials. July 29; six months.

John Henry Roberts, of Norfolk Villa, Finchly road, Saint John's-wood, surgeon, for improvements in spirit lamps. July 29; six months.

George Beadon, of Battersea, commander in the royal navy, for improvements in propelling vessels and land carriages, in raising and drawing off water for driving machinery, which means of raising and drawing off water are applicable to other useful purposes. July 29; six months.

Sir Samuel Brown, of Blackheath, knight, captain in her Majesty's navy, for improvements in the formation of embankments for canals, docks, and sea walls, and in the conveyance and propulsion of locomotive engines and other carriages, or bodies on canals, and other inland waters, and also on rail and other roads, and in propelling vessels on the ocean and navigable rivers. July 29; six months.

Cabel Bedells, of Leicester, manufacturer, for improvements in weaving. July 29; six months.

Ezra Coleman, of Philadelphia, America, for improvements applicable to moving of locomotive engines on inclined planes of railways. July 30; six months.

John Paltrineri, of Skinner's-place, Size-lane, London, gent., for certain new and improved modes of obtaining and applying motive powers. August 30; six months.

Joseph Quick, of Summer-street, Southwark, engineer, and Henry Austin, of No. 10, Walbrook, civil engineer, for improvements in the construction and working of atmospheric railways. July 31; six months.

William Cook, of King-street, Golden-square, coach maker, for an improvement in certain descriptions of stoves. July 31; six months.

Pierre Armand Leconte de Fontainemoreau, of Skinner's-place, Size-lane, for certain improved medicines or compounds, and for the application of a new instrument to prevent, alleviate and cure certain diseases, also for the machinery for manufacturing the said instruments. (Being a communication.) August 4; six months.

William Longmaid, of Plymouth, gent., for certain improvements in the manufacture of chlorine, in treating sulphurous ores and other minerals, and in obtaining various products therefrom. August 4; six months.

Josiah Marshall Heath, of Winchester-buildings, iron master, for improvements in the manufacture of cast steel. August 4; six months.

William Young, of Paisley, manufacturer and dyer, and Archibald McNair, of the same town, merchant, for certain improvements in the construction and means of manufacturing apparatus for conducting electricity. August 4; six months.

Charles Henry Joseph Forres, of Lille, in France, but now of 17, Great St. Helens, Bishopsgate, gent., for a new and improved Archimedean screw, which he calls "Davaine's Screw." (Being a communication.) August 4; six months.

Alanson Abbe, of Great Russell-street, Bloomsbury, M.D., for improvements in apparatus for preventing and alleviating spinal disorders. August 4; six months.

William Eccles and Henry Brierly, both of Walton-le-Dale, Lancaster, spinners, for improvements in the machinery or apparatus used in spinning. August 5; six months.

Peter Francis Maire, of Mark-lane, merchant, for improvements in combining iron and other materials for the purposes of constructing bridges, roofs, arches, floors, and other similar structures. (Being a communication.) August 5; six months.

Francis Taylor, of Romsey, Hants, surgeon, for improvements in giving alarm in case of fire, and in extinguishing fire. (Being partly a communication.) August 6; six months.

Frederick Bankart, of Champion Park, Denmark-hill, Surrey, gent., for certain improvements in treating certain metallic ores, and refining the products therefrom. August 7; six months.

John Evans, of Kensington, gent., for a new perazotic product and its application to the arts. (Being a communication.) August 7; six months.

Dalrymple Crawford, of Stratford-on-Avon, Warwick, for an improved dibbling machine. August 7; six months.

Henry Smith, of Liverpool, engineer, for improvements in the manufacture of wheels for railways, and in springs for railway and other carriages, and in axle guards for railway carriages. August 7; six months.

Henry Emanuel, of Pond-street, Hampstead, gent., for improvements in atmospheric railways. August 7; six months.

George Brown, of Caperthorne, Cheshire, land agent, for a new seed and manure-drill plough. August 9; six months.

Peter Armand Leconte de Fontainemoreau, of Skinner's-place, Size-lane, for certain improvements in apparatus for raising and supporting vessels and other floating or sunken bodies, and its

application for the better preservation of life and property. August 9; six months.

Frank Hills, of Deptford, manufacturing chemist, for improvements in purifying gas for illumination, and obtaining a valuable product in the process. August 9; six months.

Charles Searle, of Bath, doctor of medicine, for improvements in stoves. August 9; six months.

Hypolite Louis François Salembier, of Mincing-lane, merchant, for improvements in the manufacture and refining of sugar. (Being a communication.) August 9; six months.

Peter Higson, of Clifton, Lancaster, mining engineer, for certain improvements in machinery or apparatus for connecting and disconnecting the steam engine, or other motive power with or from the load, or other matter to be driven or moved. August 9; six months.

William Newton, of Chancery-lane, civil engineer, for improved modifications and novel applications of known machinery, and processes to the purpose of cleaning, softening, dividing and preparing flax, hemp, and other vegetable fibrous materials. (Being a communication.) August 14; six months.

Thomas Henry Russell, of Wednesbury, Stafford, tube manufacturer, for improvements in the manufacture of welded-iron tubes. August 14; six months.

Henry Pearse and William Dimsdale Child, both of Finsbury-place South, for improvements in the manufacture of sugar. (Being a communication.) August 21; six months.

Thomas Oxley of Westminster-road, civil engineer, for certain improvements in constructing and propelling vessels, and in the machinery connected therewith. August 21; six months.

LIST OF PATENTS GRANTED FOR SCOTLAND, FROM THE 22ND OF JULY TO THE 22ND OF AUGUST, 1845.

Thomas Grubb, of Dublin, civil engineer, for improvements in bank notes and in machinery connected therewith, parts of which are also applicable to cheques, bills, and other documents. Sealed, July 23.

William Yates, of Manchester, Lancaster, upholsterer, and Dennis Dolan, of the same place, scagliola manufacturer, for certain improvements in plastic manufacture, or composition, part of which is applicable to decorative and useful purposes, and part as fire-proof cement or plaster. July 28.

William Shaw, of Canning-place, Liverpool, printer and account book manufacturer, for a machine for paging books and numbering documents consecutively and otherwise, and for printing dates, words, marks, or impressions in an expeditious manner. July 29.

Isham Baggs, of Great Percy-street, Claremount-square, Middlesex, engineer, for improvements in obtaining motive power by air. July 29.

William Pollard, of Newcastle-upon-Tyne, gent., for certain improvements in the production of combustible gases and in the application of the same as fuel. July 30.

Richard Simpson, of the Strand, London, gent., for certain improvements in bleaching yarns and fabrics. (Being a communication from abroad.) July 31.

William George Henry Taunton, of Liverpool, civil engineer, for certain improvements in machinery for revolving windlasses, barrels, spindles, shafts, and for pumping. July 31.

John Macintosh, of Glasgow, gent., for improvements in preparing materials for colouring and printing calicoes and other fabrics, and improvements in printing and ornamenting fabrics. August 6.

Thomas Clarendon, No. 213, Great Brunswick-street, Dublin, gent., for an improved method of shoeing horses and other beasts of burden. (Being a communicatin from abroad.) August 5.

Alexander Wilson, of Glasgow, Lanark, manager for Alexander Fletcher and Co., flax spinners, Glasgow, for improvements in spinning hemp and flax, and other fibrous materials. August 6.

John Parsons, 2, Stone's-row, Saint Pancras, Middlesex, machinest, for certain improvements in the manufacture of fuel, and in the apparatus for the use of the same. August 8.

Frederick Herbert Maberly, of Stowmarket, Suffolk, clerk, master of arts, for certain improvements in machinery or apparatus for stopping or retarding railway and other carriages, applicable also to other purposes in regard to other engines or wheels. August 8.

Elias Robison Handcock, 16, Regent-street, Middlesex, esq., for certain improvements in mechanism applicable to turntables for changing the position of carriages and engines on railways, which improvements are also applicable to cranes and other purposes. August 8.

William Young, of Paisley, manufacturer and dyer, and Archibald McNair, of the same town, merchant, for certain improvements in the construction and means of manufacturing apparatus for conducting electricity. August 12.

George Bell, of Pembroke-road, Dublin, merchant, for certain improvements in drying malt, grain and seeds. August 12.

NOTES AND NOTICES.

Safe Arrival of the Great Britain—Triumph of the Screw.—We have great pleasure in recording the safe arrival of the *Great Britain* at New York, on the afternoon of the 10th inst., after a fine passage of 14½ days. Westerly winds prevailed during the voyage, and at times she encountered fresh gales, cross seas, and thick fogs; but she held her way, notwithstanding, most bravely, and the engines were not stopped one moment until her arrival off Sandy Hook.

New Locomotive Agency.—The following is an extract from a letter from Philadelphia, published in the *Memorial de Rouen*;—" William Evans has resolved a problem, which must overturn our present system of railway and steam-boat propulsion. By means of enormous compression, he has succeeded in liquifying atmospheric air, and then a few drops only of some chemical composition, poured into it, suffice to make it resume its original volume with an elastic force quite prodigious. An experiment on a large scale has just been made. A train of twenty loaded wagons was transmitted a distance of sixty miles in less than an hour and a quarter—the whole motive power being the liquid air enclosed in a vessel of two gallons and a half measure; into which fell, drop by drop, and from minute to minute, the chemical composition in question. Already subscriptions are abundant, and a society is in course of formation. The inventor declares, that an ordinary packet-boat may make the passage from Philadelphia to Havre in eight days, carrying a ton of his liquid air. A steam-engine, of six-horse-power, will produce that quantity in eight hours."

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1152.] SATURDAY, SEPTEMBER 6, 1845. [Price 3*d.*
Edited by J. C. Robertson, No. 166, Fleet-street.

DE LA HAYE'S SUBMARINE RAILWAY.

Fig. 1.

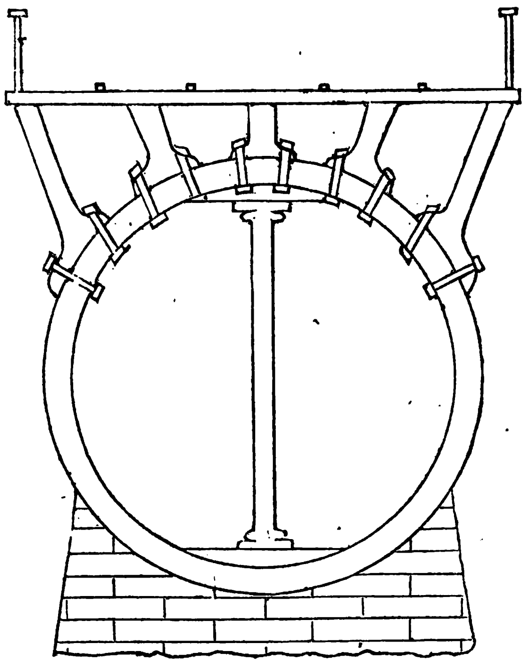
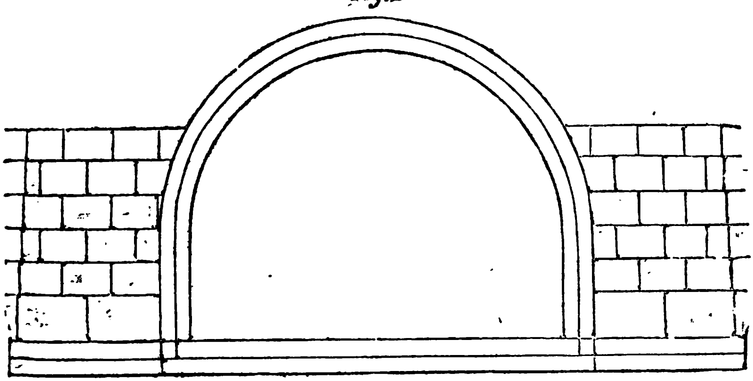


Fig. 2



MR. DE LA HAYE'S PLAN OF A SUBMARINE RAILWAY.

RESPECTED FRIEND,—Having thought for some years, that submarine railways might be constructed in rivers and narrow seas, I take the liberty of intruding on thy notice the following plan, by which I consider this object may be attained. The plan is to construct wrought-iron tunnels, and then to place them on the bed of the sea.

I beg to state, that according to a promise which I received from Sir Joshua Walmsley, to whom I had submitted my plan, a copy of it must have been in the hands of George Stephenson at least ten months; perhaps that engineer will not refuse to confess, that his plan for the tunnel over the Menai Straits was copied word for word from my plan, with the only modification of suspending it above the water.

I would construct wrought-iron tunnels in divisions of about 400 feet in length, by making a frame, or rather skeleton work, of strong wrought-iron bars, or ribs, in such a manner as to admit of three distinct sets of iron plates being riveted to it; the space between the plates I would fill with a mixture of tar, pitch, and sawdust, so that even if the outer plate received any injury, the water could not enter the tunnel.

The whole of the divisions being built, I would block up both ends with a temporary framework of wood and iron; then I would launch them at sea, and tow them to the spot by means of a steam vessel. I would then fill them with water by the stop-cocks, so as to cause them to sink on the bed of the water; the divisions should then be temporarily connected outside from diving bells, then the water pumped from inside, the temporary blockading frames removed, and iron plates screwed between the divisions, so as to render the whole as one vast building.

To prevent the tunnels from rising by their buoyancy, they should be constructed with a wide platform on each side, as represented in figure 1.

A number of very large stones should be let down on the platform on each side, in sufficient number to keep the tunnel in its position; these stones should of course be placed below, previous to pumping the water from the inside.

Supposing it were possible to construct such a tunnel between Dover and Calais, it would be necessary to sink the divisions near the shore below the bed of the water, by forming a kind of canal for their reception; this would protect the building from the violence of the waves while in deep water, as it has been ascertained, I believe, that the sea is not agitated in great depths, even in the most violent storms. I believe that the bed of the channel is sufficiently level to admit of such a building being placed on it. I am aware, however, that the expense would be very considerable, though probably much less than if a tunnel were bored under the bed of the channel, and attended with very little danger.

In rivers it would be necessary to sink a great part of the tunnel below the bed of the water, because the centre of rivers is considerably deeper than near the sides; and in fact, by placing nearly the whole under ground it would offer no impediment to the navigation of the river.

Wrought-iron tunnels might also be used instead of suspension bridges, and would undoubtedly be much stronger. I would not, however, place the rails *inside*, but on the top. I would construct such a tunnel in the form of a cylinder, as represented in fig. 2.

Over the cylinder I would place a thick wrought-iron platform, supported on cast-iron mountings, so as to admit the wind passing round the cylinder; by these means the building would not be liable to suffer injury by the strongest gale. I would also place a number of cast-iron columns inside, to support the upper arch and platforms.

Smaller tunnels might be made for wider channels; these might be made of cast-iron, as they would not require being more than 3 or 4 feet diameter; rails might be placed inside, on which a small car for the mails could be drawn by a stationary engine at each end; wires might also be laid inside, for communication by means of the electric telegraph.

Another use for iron tunnels would be in parks and pleasure-grounds. Where a railway passing through destroys, in some cases, nearly half the value of the estate, an iron tunnel might be sunk under, if it were even at the inconvenience of having a considerable gradient at each

end; or in other cases, the tunnel might be only partly sunk in the ground, and the other part covered with earth, or both sides, in a sloping direction.

In fact, I consider that the modifications which this invention admits of are almost infinite.

I have now stretched my remarks to too great a length to admit of my entering into any further details at present. If thou wilt permit, I will in a future communication place my plans for sinking the bed of the water, for placing the tunnels beyond the reach of injury, and also the mode of connecting the divisions under water.

I remain respectfully,

JOHN DE LA HAYE.

8 Mo. 18th, 1845. 100, London-road, Liverpool.

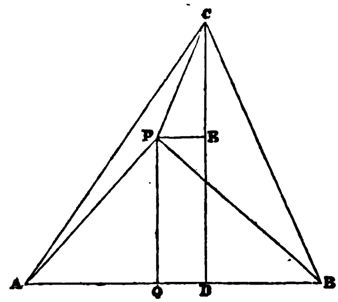
SOLUTION OF A MECHANICAL PROBLEM.

PROBLEM.—*In a certain arrangement of machinery, there are three pinions of the same pitch, but of different diameters, all moving on independent axes, which are parallel to one another, and working individually or collectively into a spur-wheel of equal pitch, moving also on an independent axis parallel to the former; it is required to determine the size and position of the spur-wheel, the diameters and distances between the centres of the pinions being severally given.*

It is easy to perceive that the object of this arrangement is to obtain three independent motions, either separately or simultaneously, according to circumstances; but the mode of solution, as the problem is here enunciated, is not very obvious; it will, therefore, be better to divest it of its mechanical technicalities, and state it in general terms, as follows:—*To find a point such that straight lines drawn therefrom, to three given points in the same plane with it, shall have given differences.* Or, otherwise, thus:—*To find a point in a given right-lined triangle, from which, if straight lines be drawn to the angular points, the differences of these lines shall be given.*

It will readily be admitted that the problem as thus generalized is the same as that proposed, the condition of different diameters being involved in the differences of the lines; but under this modification the obscurity disappears, and, in consequence, the method of solution is at once made manifest. We shall, in the first place, endeavour to resolve the problem algebraically; we are aware, *à priori*, that the equation, when brought to its ultimate form, will assume a very complicated aspect, by reason of the number of terms that it must necessarily involve; but when applied to the solution of a specific example, the complexity will in a great measure disappear; as in that case the several symbols will be replaced by their equivalent numbers, and the equation will be reduced to a form ready for solution. The operation in this way is as follows:

Let A B C be the plane triangle, of which the sides A B, A C, and B C, are given, and let P be the position of the point required; then, by the problem,



the point P must be so placed, that the straight lines P A, P B, and P C, drawn from it to the angular points A, B, and C, shall have given differences.

From the vertex C, upon the base A B, let fall the perpendicular C D, dividing A B into the segments A D and B D, whose values can be determined; and from the point P let fall the perpendiculars P Q and P R, meeting the base A B in Q, and the perpendicular C D in R; then we have formed the right-angled triangled triangles A Q P, B Q P, and P R C, having the required lines P A, P B, and P C, for their hypotheneuses respectively, P B being assumed the greatest. From this construction, the method of forming the three independent equations by which the position of the point P is to be determined, is obvious.

Put a = A D, one segment of the base made by the perpendicular C D,

$b=$ B D, the other segment,

$c=$ C D, the perpendicular from the vertex on the base A B,

$d=$ P B $-$ P A, the difference between the lines drawn from P to the angles A and C,

$\delta=$ P B $-$ P C, the difference between the lines drawn from P to the angles B and C.

These are the several *data* concerned in the problem, and which are either directly given, or can be found from the figure by well-known geometrical principles; and the following are the *incognita*, or things unknown, viz.,—

$x=$ D Q, the distance between the perpendiculars C D and P Q, from the points P and C.

$y=$ P Q, the perpendicular distance between the base A B and the required point P.

$z=$ B P; the distance between the angle at B and the required point P, being greater than either of the other two distances, P A, or P C.

Then we have

A Q $=$ A D $-$ D Q $=a-x$;
B Q $=$ B D $+$ D Q $=b+x$;
C R $=$ D C $-$ D R $=c-y$;
P A $=$ P B $-d=z-d$;
And P C $=$ P B $-\delta=z-\delta$;

therefore, by the property of the right-angled triangle, we get the following equations, viz.,—

1. B P$^2=$ B Q$^2-$ P Q^2; that is .... $z^2=b^2+2bx+x^2+y^2$.
2. A P$^2=$ A Q$^2-$ P Q^2; that is ... $z^2-2dz+d^2=a^2-2ax+x^2+y^2$.
3. C P$^2=$ C R$^2-$ P R^2; that is ... $z^2-2\delta z+\delta^2=c^2-2cy+x^2+y^2$.

Now, since we have assumed the straight line P B to be greater than either P A or P C, it follows that the first equation is greater than either the second or third; for this reason, let each of them be subtracted from the first, and we shall have the two following remainders, viz.,—

4. $2dz-d^2=b^2-a^2+2bx+2ax$.
5. $2\delta z-\delta^2=b^2-c^2+2bx+2cy$.

From the fourth equation, by transposition and division, we get

$$x=\frac{2dz+a^2-b^2-d^2}{2(a+b)};$$

and, in like manner, from the fifth, we have $y=\dfrac{2\delta z-2bx+c^2-b^2-\delta^2}{2c}$; then for x, in this latter expression, substitute its value in the former, and we obtain

$$y=\frac{(a+b)\ (2\delta z+c^2-b^2-\delta^2)-b\ (2dz+a^2-b^2-d^2)}{2c\ (a+b)}.$$

Let the square of this value of y, together with the values of x and x^2, as obtained above, be substituted instead of them respectively in No. 1, and we shall obtain the following equation, involving only z and known quantities:—

$$z^2=b^2+\frac{b\ (2dz+a^2-b^2-d^2)}{(a+b)}+\left(\frac{2dz+a^2-b^2-d^2}{2\ (a+b)}\right)^2+$$
$$\left\{\frac{(a+b)\ (2\delta z+c^2-b^2-\delta^2)-b\ (2dz+a^2-b^2-d^2)}{2c(a+b)}\right\}^2.$$

Here, as we anticipated, the equation is of a very complicated form; and if actually expanded, according to the exponents of the terms, it would become much more involved; we shall therefore withhold the expansion in the present instance, with the notice that when numbers are introduced for the several known quantities, many of the terms will disappear, and the result will be obtained by the resolution of a quadratic equation.

ELECTRO-CULTURE—EXPERIMENTS.

Sir,—I do not know whether the contents of this note may be worthy of a place in your Magazine, but as you published there an account of the experiments to which they relate, I fancied they might possess some interest.

The experiments to which I allude are those made by Mr. Ross, of New York, in "Applying Galvanism to growing Potatoes," a description of which will be found in the *Mech. Mag.* vol. xli. p. 224; and those by Mr. Forester, of Findrassie,

"on the application of Atmospheric Electricity as a promoter of Vegetation," described in vol. xlii. p. 90.

I have made, very carefully, both these experiments, the first in my own kitchen garden; the second by permission of a friend in a field of wheat: the results are as follow.

The rows of potatoes, which were taken indifferently, between the metallic plates, yielded a crop, not more in number than, but very nearly double in size and weight, that yielded by the other rows.

The wheat enclosed by the parallelogram of wires has never exhibited the slightest difference from that in other parts of the field, and there is no appreciable difference between its produce and that of equivalent areas surrounding it. It should, however, be stated, that the wires were not applied at the time of sowing the seed, nor until the 24th of February, after reading the account given in your Magazine of the 8th of that month.

The result of this experiment, instead of discouraging the efforts now making to applying this powerful agent as a "promoter of vegetation," should, I think, rather operate as an inducement to improve on the *present method of applying it;* which, I must be excused for saying, does strike me as being somewhat empirical.

I hope to be able next year to repeat these experiments with such variations as may be suggested, or which may occur to me; and should the results be worthy of your notice, I shall be happy to forward them to you.

I am, Sir, your obedient servant,

THOMAS DELL.

P.S. I should have mentioned, that the directions given in the articles I have quoted, have been most rigidly followed.

Aylesbury, August 29, 1845.

A TREATISE ON FACTORIAL ANALYSIS, WITH THE SUMMATION OF SERIES; CONTAINING VARIOUS NEW DEVELOPMENTS OF FUNCTIONS, ETC. BY THOMAS TATE, MATHEMATICAL MASTER OF THE NATIONAL SOCIETY'S TRAINING INSTITUTION, BATTERSEA, AND LATE LECTURER ON CHEMISTRY IN THE YORK SCHOOL OF MEDICINE. BELL, 1845.

A portion of this work was "read before the Royal Society," and the whole is now published by the author: a sure indication of its having been rejected by that learned body—or, in official parlance, "deposited in the Archives." We have met with similar instances often enough; and some of them show that the Council of the Society exercised a sound discretion. In many others, however, there are internal (and, now and then, external) evidences that the paper had either been misunderstood as to purpose and value, or else that motives less worthy than even ignorance operated upon the referee to whom the paper had been assigned for a "Report." *We*, of course, cannot know to whom Mr. Tate's paper on Factorials was referred, or the grounds assigned for recommending the "Archives" instead of the "Transactions" as its fitting destination. In fact, we know of no conditions whatever being required to be fulfilled in the quality or subject of a paper, which the Society lays down as a criterion of its approbation or condemnation. The Reports are secret—even the Reporter's name is not minuted—and the author is left at the mercy of this Star-Chamber jurisprudence, with all the ill-will, jealousy, or personal animosity of the Reporter himself, or his friends!

It would be impossible even to guess at the amount of wrong which such an engine as the Royal Society's Council may heap upon young scientific men, and through them upon the sciences themselves: but it does now and then happen, that a little insight is gained into the operation of this system, by the authors undertaking, themselves, to publish their respective papers. Dr. Granville enumerates many instances of such unblushing effrontery in the Council and its minions, as would shame almost any corporation, except the actual perpetrators of such deeds. His enumeration chiefly turns upon physiological and chemical science; and we would instance, in mathematical papers,—the late Mr. Horner's paper on Transformation,—Mr. Barrett's paper on the Calculation of Life Annuities,—Mr. Weddle's paper on the Resolution of Numerical Equations*—and,

* Is it true that this paper was rejected on the suggestion made by the Junior Secretary, that he

finally, Mr. Tate's Factorial Analysis, now before us. Each of these papers would have conferred honour on the Royal Society's "Transactions:" but it is now sufficiently well known that mathematical papers, except they emanate from the members of the coterie, do not find favour in the eyes of this august body. From the rejection of Mr. Tate's paper, we may at once infer that he is not one of that body, nor even a parasitical *attaché* of any Somerset-place-going member. We could, indeed, scarcely suppress a smile at the child-like simplicity of Mr. Tate in stating, that for the portions recently read before the Royal Society, "the author had received the thanks of that learned body." It is quite clear that he has never witnessed the *process of returning thanks* by the Society; nor does he fully comprehend the force of the *barely civil* letter in which the Secretary conveys to him the information of the award; nor, again, does he seem to remark, that such thanks are returned for *every* paper read before the Society, whatever be its nature, subject, value, or authorship—merely an acknowledgment of the receipt of the paper, but neither giving nor implying any opinion as to its merits. That opinion is given in private; and all that the Society itself can learn, without the pleasure of the Council, is that "A" or "T" is affixed to it, as the case may be. The author and the public can only infer from its not appearing in the Transactions, that it is consigned to the Archives. This is the criterion, the only one, of the views of the Society as a body, represented by its Council. We could wish that young aspirants for scientific distinction would rather publish their investigations in an independent shape, than delude themselves with the absurd belief, that the Royal Society is employed for fostering science, and for giving encouragement to the researches of any but its own little clique.

But it is time to leave this ungracious subject, and return to Mr. Tate's little volume. The "Introduction" is a splendid composition—full of large conceptions, and yet marked by the chastened views of a mind disciplined to severe reasoning. Mere formulæ are not "everything" with him: the understanding of these formulæ is viewed by him as alone completing the analytic mind. It is, indeed, easy enough to work from general formulæ downwards to particular cases; and there are minds which are extremely inventive in the way of combining symbols, that cannot descend to, or explain a single difficulty, or interpret a single special result at which they may arrive. Mere power in the combination of symbols, however, in the general estimation, constitutes a great analyst; and this "vulgar error" seems likely to keep its hold upon the public mind for some time to come. Still, we see symptoms of a better spirit—of a spirit which insists upon the understanding being employed in conjunction with the hocus-pocus of symbolising. We do not undervalue the art of symbolising: but we know that the air of mystery which (like the ancient priesthood with its oracles and other arcana) mathematicians tacitly conspire to throw over their formulæ, tends to keep up a kind of unhealthy wonder and veneration in the public mind. But this is waning too: and such men as Mr. Tate freely expressing their views, whilst they give such evidence of their own power over algebraic formulæ, will do much to hasten this desirable mental reformation.

Amongst our own readers we know there are many men of high intellect and mathematical power; and, indeed, the contributions of many of them to our pages, is a proof that *time* is the only element wanting to give them scientific positions that would sadly disturb the serenity of the Royal Society's Council. Let them, however, not be seduced into the regions of symbology one step further than their path is enlightened by their own understanding. Let them

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had himself *previously* discovered an analogous mode of investigation? Had he published that method, or indeed given any publicity to it? We have heard that it is to Mr. Weddle's method, that Professor Christie refers in that very jesuitical passage at p. xi. of the Preface to his "Course of Mathematics," and which has been animadverted upon with just indignation in a contemporary work—Wade's London Review, June 1845. We should indeed like to see Mr. Christie's attempt to show the identity, or even the most distant similarity, between his own *appropriation* of Nicholson's process and Mr. Weddle's peculiar and truly original one. This would be a match for his celebrated experiment to prove the magnetism of his own denuded person!

eschew the intoxicating influence of mere manual mathematics—mere eye-work, in which the mind itself is not the guide: aye, let them eschew it as they would the physical intoxication administered by the Whitbreads, the Barclays, the Booths, and the Beaufoys. Nevertheless, as far as their understanding goes with them, let them push on—boldly and fearlessly: for so long they are safe, and they are safe no further. Let all our readers, too, aid us in enforcing this fundamental principle upon the young student; and to induce still further attention to it, we will quote one single passage from Mr. Tate's preface, pages v. and vi., viz.:—

"To those who are in the habit of considering differentiation as the universal solvent of all methematical difficulties, not a few of the methods of investigation employed in this work will appear tedious and operose. Taking for granted some of our great analytical principles and theorems, it becomes an easy task to establish, by a deductive process, formulæ of less generality. There is a charm in this deductive process, and a factitious though an entire confidence in the accuracy of our results; for we employ formulæ which have received the tribute of admiration from the genius of all nations, and which may have shed a light upon the works of nature, or given rise to some of the most magnificent discoveries in art. It is nevertheless true, that the too frequent use of these general forms leads us to undervalue principles which would enable us to work out results more simply, if not more elegantly, than by differentiation or integration. *Such methods disguise the real difficulties of a problem; for while it is easy to understand the meaning and use of a general formula, every mind cannot at once appreciate the principles of reasoning upon which the demonstration of that formula is based. By the application of a rule, transformations are effected which save the exercise of thought, and the labours of development: but the rigid solution of a problem, or the complete demonstration of a theorem, calls into vigorous operation the slumbering energies of the higher intellect, and may thus exercise an important influence upon the whole of the student's career.* The love of truth is a lamp to the soul, and sheds a holy light over the whole of our destiny; but this sentiment can only be duly cherished by habituating ourselves to exact methods of thought."

The doctrine and properties of Factorial Functions have something so attractive in their character (arising from the symmetry of the terms and the regularity of law which runs through a series) that with most persons entering upon mathematics, they have been subjects of predilection. The use of a contracted notation, which an extensive investigation renders imperative, has discouraged many persons from pursuing the subject to any great extent; even though they were fascinated with the elementary theorems which presented themselves in such profusion. The particularly neat way in which Mr. Tate has laid down the elementary steps, has removed all difficulty from the path of the student of the most common-place abilities, provided he be ready in ordinary algebraic operations, and clear in his conceptions of the force of symbols. These prefixed details are, we apprehend, the chief additions to the paper sent to the Royal Society; and for a book addressed to the mathematical million, these details were *necessary*. We are glad, too, to say, in mathematical phrase, that they are also *sufficient*: so that the two conditions required in such a work are fulfilled.

Every problem, properly limited, which does not admit of a finite solution, does yet admit of a solution in a series; and this series always takes a factorial form in the composition of its terms—the number of factors being either uniform or increasing from term to term, according to a law discoverable in each particular case. Few, indeed, of the problems which occur in physical or mechanical science admit of a finite solution (perhaps not one in ten thousand); and it is hence of the first importance to investigate methods of finding the limiting sums of the infinite series into which the solution of so many problems develop themselves. To this purpose many of the greatest of the continental analysts have devoted much of their labour; and in this country, too, the subject has of late years attracted some attention. The factorial method has not, however, been so applied by writers in general; but each one has rather

followed out some special and confined method peculiar to himself, and adapted to particular forms of series, to which the methods were applicable. The most ample and original work which had been published before Mr. Tate's was, undoubtedly, Sir John Herschel's supplementary volume to Lacroix, founded on the method of Differences, finite and differential; but we conceive the principle of Factorials to be both more elementary and more powerful. Many of the *results* in Mr. Tate's work are new; or, at least, in a tolerably extensive course of reading, we have not met with them, nor with anything like them. Many known theorems, too, are deduced with great beauty and simplicity; and in a manner more easy of comprehension (admitting that the fundamental principles of factorial notation are understood), than we have yet met with in print.* As the author has, in his preface, mentioned the theorems, which he considers to be essentially both new and important, we need not quote them here; but we have much confidence that his own estimate will be found to be ultimately correct; and certainly none of them, nor any immediate approach to them, is to be found in the works which are ordinarily admissible to English students—even should there prove to be such in any of the voluminous and inaccessible collections of the foreign acadamies. For these reasons, then, we feel we are not only doing justice to Mr. Tate, but rendering a service to our readers in recommending to them a *careful study* of Mr. Tate's "Treatise on Factorial Analysis."

It may not be amiss, in conclusion, to make one remark on factorial notation, as a necessary preliminary to the study of Mr. Tate's work. It is merely an extension of the ordinary indicial system by which powers and roots are expressed—or perhaps we should say, a *variation* of it. The expression $(x + a^n)$ means $(x+a)\ (x+a)\ \ldots\ (x+a)$, the number of equal factors being n; whilst, when each successive term is increased or diminished by a constant quantity, *something more* in the shape of symbolical indication is required, which shall yet reduce to this, when the increment or decrement is 0. Thus, if there be n factors,

$$(x+a)\ (x+2a)\ \ldots\ (x+na),$$

we could not write it $(x+pa)^n$, where p was any number capable of determination. Two modes have been devised for this purpose, which have a very intimate relation (those of Vandermonde and Kramp), which are very expressive, besides others which have little else than an air of mystery to recommend them. In Kramp's method the first term is written as the base, and the number of terms as an index, precisely as in the binomial theorem; and in line with the index, separated by a vertical bar, is written the increment itself, or the decrement with the *minus* sign (either prefixed or over it) as in the negative indices of logarithms of quantities less than unity. Thus $(x+a)^{n\,|\,a}$ would express in Kramp's notation the preceding factorial; where $x+a$ is the first term, n the number of terms, and the a to the right of n expresses the increment in passing from term to term. If the terms had sustained decrements each equal to a, then the indicial part would have been written either $^{n\,|\,-a}$, or $^{n\,\overline{|}\,a}$. The method was first introduced into England by Nicholson, in his "Method of Increments," nearly thirty years ago; but he makes no reference to Kramp, and might have devised it independently. The method of Vandermonde, which was no doubt the origin of Kramp's, (being published nearly seventy years earlier) is to use *brackets* instead of the parentheses, making a marginal remark as to the amount of the increment or decrement; so that his notation for the preceding expression is simply $[x+a]^n$. The real improvement made by Kramp is, then, the annexation of the increment *in the notation itself*, separating it from the index by the vertical bar. Mr. Tate has also introduced the increment into the notation; but placed it below the body of the line as the index is placed above; so that, by him, the expression already quoted is written $[x+a]^n_a$. From mere habit, we

* We use this last word advisedly, and for reasons which will at a future time be made manifest; but in no respect to detract from the value or originality of Mr. Tate's researches.

confess "we feel more at home" in the use of Kramp's notation—that is, to our own eye, from its greater familiarity with Kramp, the expression appears *more immediately intelligible:* but we at the same time admit, that Mr. Tate's notation is the preferable, both on the ground of concentration and general analogy.

We shall feel disappointed if Mr. Tate does not follow out this enquiry still further. He possesses a powerful engine, and we beg of him for the sake of his own reputation, and for the sake of science, to test its utmost powers; and we take our leave of him and his book with the valediction—God speed!

A SELF-ACTING TOLL KEEPER.

Fig. 1. Fig. 2. Fig. 3.

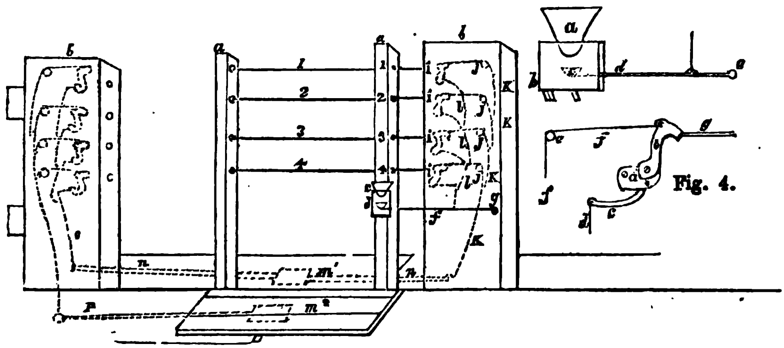


Fig. 4.

Sir,—The above sketches represent a "*self-acting* toll keeper," which, though very curious, and even wonderful, is, I fear, like many wonderful things, not very likely to prove useful. These are its "properties:" 1st, It opens of itself; 2nd, nobody can pass through without paying; 3rd, it will admit four classes, viz., horsemen, gigs, carriages, and coaches or laden wagons, each at different, and fixed prices. It consists of four wires (fig. 1) 1, 2, 3, 4. These slide easily and independently of one another, in the holes 1, 2, 3, 4, which are bored in the posts *a a*; *b b* are two boxes fixed upright in the same line with *a a; c* is a funnel for receiving the money, one end of which is inserted in the box *d*. For understanding this see Fig. 3, where *a* is the funnel; *b*, the box; *c*, a scale within the box, the top of which must be flat and slippery; *d* a rod, fixed to *c*, and having a hinge at *e*; *f* a line attached to *d*. The money falls through a slit in the bottom of *a*, on to the scale *c*, by weighing down which it pulls the line *f*, and so removes as many of the rods 1, 2, 3, 4, as there is money. The mode of doing this is simple: *i i i i* are four locks, of the same construction as those of a gun, only much larger and stronger. Fig. 4 is a large view of one of these; *a* is the lock plate; *b*, the hammer; *c*, the trigger, to which the line *d* is attached; *f f* is a line to cock it, going over the pulley *e; g* is the end of one of the rods, 1, 2, 3, 4. J J J J are three pulleys; K K K K are the lines passing over them, for the purpose of cocking; they are all tied to one another. The reader will observe from the engraving, that the lowermost of these lines (K) and together with it, the lowermost of the lines *l l l l*, which are tied to the triggers, is tighter than the one above it, which is, in its turn, tighter than the next, and so on *upwards*. The intention of this is, that the lowermost *lock* may be cocked before the one above it, that one before the next, and so on; and in the case of the lines, (*l*), that the lowermost *trigger* may be pulled before the second, the second before the third, and the third before the fourth. It has been stated before, that the line *l* (which is the same as *f*, in fig. 2,) is pulled by the sinking of *c*, and therefore, of *d*. m^1 and m^2 are two boards or plates of iron, similar to those seen at wharfs, for weighing wagons. m^1 has two shafts, *n n*, fixed to it underground; the one on the right-hand side has the cocking line K attached to it, the other

has the line *o*, which pulls the triggers, on that side. m^2 has only one shaft, P, which cocks the locks on the left-hand side. It will be seen that the locks, &c., on this side, are of the same construction as those on the other side. Now, suppose a horseman arrives at the gate; first his horse treads on the plate m^2, which by that means cocks the triggers on the left-hand side (which have been left fired by the preceding vehicle); next he puts his money into the funnel *c*; the rod *f* sinks, and pulls the line *l*; the lowermost lock is thus discharged, and the lowermost rod 4, is driven into the partition on the left-hand side, thereby leaving room for the horseman to pass underneath. On the other side of the gate, he treads on the plate *l*, and so cocks the lock on the right, which he before had discharged, and fires one on the left, to drive the rod 4 back into its place. As a gig pays double what a horseman does, two of the rods would be *thrown across*, and so on. As it is worked by *weight*, of course one penny must be put in. Such is the Self-acting Toll Keeper. I hope I have made it sufficiently intelligible.

I am, your constant reader,

Θεωνδωρον.

ATMOSPHERIC PROPULSION.

Sir,—In the present volume of your Magazine, page 85, you have inserted some "Notes of a Mechanic," the first of which suggests a supposed new mode of atmospheric propulsion. Will you allow me to inform your correspondent, through your useful pages, that a system of atmospheric propulsion, almost identical with that which he proposes, was patented by Mr. Pinkus in, I think, the year 1842. The only difference which I at this moment recollect was, that the piston cylinders, upon being placed by the passing train in communication with the main tube (and therefore in action), communicated their power, *not immediately* to the train, as your correspondent suggests, but through the medium of wheels, which they caused to revolve, and which then, either by their frictional hold on a bar, or by cogs on a rack attached to the carriages, propelled the train. The last carriage of the train again shut off the communication between the cylinders and the main tube.

I think I see in the tone of your correspondent's remarks enough to assure me that he will rather rejoice than be disappointed in finding that others have thought of the same thing as himself, and that he knows and appreciates the saying which explains away many a supposed plagiarism, viz., "They who think rightly think alike."

I remain, Sir,

Your obedient servant,

HUMILIS.

August 28, 1845.

MODE OF CHECKING ATMOSPHERIC RAILWAY ENGINES IN DESCENDING INCLINED PLANES.

Sir,—The principal objection to the atmospheric system of railway propulsion urged by your correspondent, Mr. Lipscombe, appears to me easily remediable, viz., that no unobjectionable means have been proposed to avoid the propelling power during the descent of an incline. I apprehend that the following method will obviate the difficulty:

We will take a tube of three miles in length, in which, at some intermediate part, there is an incline, wherein safety compels the cessation of propelling power. The main tube may be continued the whole length, but remain *open* the distance of the incline. Let a closed tube of equal diameter diverge at the summit, and run parallel with the main tube, and be also in connection at the base of the incline. A revolving double valve—similar to those already used on atmospheric railways—is to be attached at each junction of the double tubing. The piston, on arriving at the upper junction will close the valve of the secondary tube, at the same time opening the partition in the main tube. The train will then descend the incline in connection with the open tube; consequently, no power will be applied. On arriving at the base of the descent, the revolving valve at the lower junction will again be opened by the piston, and the air being admitted into the secondary tube, the valves will resume their original position, the train proceeding as usual. This may be repeated several times between two stationary engines.

I am, Sir, your obedient servant,

R. W.

Cornhill, September 1, 1845.

DESCRIPTION OF THE GREAT BRITAIN IRON STEAM SHIP, WITH SCREW PROPELLER; WITH AN ACCOUNT OF THE TRIAL VOYAGES, BY THOMAS RICHARD GUPPY, ESQ. C.E.

[From the Proceedings of the Institution of Civil Engineers.]

(Continued from page 155.)

The steam-engine employed to drive this screw consists of four steam cylinders, each of 88 inches in diameter, by 6 feet stroke, into which steam is admitted by piston valves of 20 inches in diameter.

As it is very troublesome to lift large cylinder covers, manholes are made in them, and in the pistons, so that the bottoms of the cylinders can be easily examined.

The large diameter given to the steam cylinders was purposely with a view to working very expansively, and on the trial recorded, the steam, being at 4 lbs. pressure in the boiler, was throttled on its passage and cut off by the expansion valve at one-sixth of the stroke, that is, 1 foot from its commencement.

The connecting rods of these engines are applied in pairs to crank pins, at either end of the main shaft, and the same crank pin carries the connecting rod of one air-pump, of the same length of stroke by 45½ inches in diameter.

This air-pump is inserted in the wrought-iron condenser, which receives the steam from the cylinders.

The main shaft is of wrought-iron, 17 feet long by 28 inches in diameter, in the centre, and 24 inches in the bearings, which are 30 inches long; through this shaft, as through the cranks and crank pins, a hole is bored and a stream of cold water is constantly injected, which has an important influence in keeping the bearings cool.

Upon this main shaft, is a toothed drum, of 18 feet in diameter, with a face 38 inches in width, around which, and a lesser drum of 6 feet in diameter, placed below it, four sets of pitched chains work; the motion of which is remarkably smooth and noiseless. Each set of these chains consists of two links and three alternately: the sectional area of the four sets is 24 inches.

The best method of giving the requisite speed to the screw shaft was long under consideration, and the usual means, by gearing, straps, &c., were not overlooked; but each appeared to have some objectionable quality; at length Mr. Brunel suggested the pitched chain, which was finally adopted.

These links were very carefully forged, they were then brought to a dull red heat and placed in a proving machine, where they were stretched one-eighth of an inch, and while in that state they were rigidly examined. After boring and planing, they were all finished on one gauging tool and case-hardened.

As the engines are intended to work at 18 revolutions per minute, and the speed is got up at the rate of nearly 2·95 to 1, the screw will then make about 53 revolutions per minute.

The lower shaft, to which the screw is attached, consists of three lengths. On the first, which is 28 feet 3 inches long, by 16 inches diameter in the journals, is fixed the lesser drum, which is 6 feet in diameter, and at the forward end of this is the step, which resists the thrust, or effort of the screw, which will be presently described.

The second piece is a hollow-wrought iron shaft, 61 feet 8 inches long and 30 inches in diameter, formed of two courses of plates each three-fourths of an inch thick, riveted together by countersunk rivets 1⅜ inch in diameter.

The third piece is 25 feet 6 inches long; and as the screw has no bearing at its outer end, it is 17 inches in diameter in the journal, just within the stern-post.

The shaft does not rest in the stern-post, but in another bearing, outside of it, and the water is kept out by a packing, composed of leather and copper.

The thrust, or effort of the screw, is received by a step, composed of a steel plate 2 feet in diameter, against which a gun-metal plate, of similar diameter, affixed to the heel of the shaft, presses. A stream of water is admitted to a cavity, in the centre of these plates, and very satisfactorily lubricates them.

The cast-iron box of this step is very firmly attached to the frames of the engines, and in fact to the body of the ship, by wrought-iron trussing.

The boilers consist of one outside case 34 feet long, by 31 feet wide, and 21 feet 8 inches high, and this is divided into three distinct boilers, by means of two longitudinal partitions.

They have an apparatus for regulating the discharge of brine, and also a hot-water jacket, around the lower part of the funnel, into which the feed-water is pumped, and whence it flows into the boilers.

In each boiler there are four furnaces at the after, and four at the forward end; therefore there are twenty-four fires in the whole. Each furnace has its own distinct course of flues, terminating in one take-up in the middle.

The total area of the surface of the grate-bars is 360 square feet.

The total area of furnace surface exposed to the direct action of the fire, is 1248 square feet, and the total areas of the flues are,—

	Square Feet.
Of upper surface . . .	1608
Of side surface	6504
Of bottom surface . . .	1740

When the form of the engines was first decided on, it was intended that the cylinders should be 80 inches in diameter; but they were afterwards increased to 88 inches, with the view of working the steam very expansively, and thus obtaining an increase of power at a reduced expenditure of fuel.

As far as can be at present judged, this appears to have succeeded, but in consequence of the rough weather on the voyage

round, it was not possible to weigh the coal consumed.

When the *Great Britain* was commenced, the city of Bristol had taken up the subject of widening the dock-gates of the port, with other improvements, so warmly, that no doubt was entertained that, before she should be completed, there would be no difficulty in her going out; accordingly she was designed 5 feet 6 inches wider than the existing locks.

Various causes led to the abandonment, for a time, of these improvements, and the ship, when ready for sea, was not only discovered to be a prisoner, but likely to continue so, in consequence of the personal liability which it was assumed the Dock Company might incur if, by permitting any disturbance of their works, not provided for by Act of Parliament, any injurious consequences should ensue to the port.

This state of affairs lasted for several months, until at length, by an agreement between the two companies, permission was accorded to remove, first so much of the masonry and gates as would allow the ship to pass from the floating harbour into the outer basin, next to restore these, and then to adopt the same course with the gates and one side of the lock communicating with the river Avon.

This was accomplished, and the ship hauled out on the evening of the 11th of December, and at 8 o'clock on the following morning she was towed down the river Avon to Kingroad: the boilers were filled in the progress, the steam was raised, and a trip of a few hours' duration was made, the greatest speed then attained being—

Strokes of the Engine.	Multiplication of the Chain gearing.	Pitch of Propeller.		Feet.	
16½	2·948	25 feet	=	1197·25	Velocity of Propeller through the water.
Speed of the Ship		11 knots	=	111·515	
				82·10 Slip, or as ·93 to 1·	

The next trial was on the 8th January, when a numerous party of proprietors, and several engineers and scientific men were on board; but unfortunately the fog was so dense, that after waiting at anchor for several hours, the pilot, apprehensive of losing sight of the land, reluctantly consented to go a short distance, merely to gratify the visitors. On this occasion the greatest speed of the engines was 18½ strokes, the speed of the ship was 11½ knots, and the slip was 13 per cent.

On the 20th January a run was taken down the Bristol Channel, nearly to Ilfracombe and back, a distance of 95 knots, without much wind, but in a head swell, and with a balance of about two hours of tide against the ship. This distance was performed in 8 hours and 34 minutes, or at an average rate of upwards of 11 knots.

The greatest rate of engines was 18¾ strokes per minute, the steam pressure being 2½ lbs., and the vacuum 26 inches, and cutting off at 18 inches of the stroke; when the ship's speed was 12¼ knots, the slip of the screw being 9¾ per cent.

Finally, the *Great Britain* quitted the port of Bristol for London on the evening of the 23rd of January.

The masses of cloud which had traversed the sky during the day, and the occasional heavy gusts of wind, indicated the coming of the gale, which was shortly after experienced, as will be observed in the summary of the voyage (for which, see next page.)

During this voyage the engines made 52,773 strokes, consequently the distance described by the screw was 639 knots, and the actual distance traversed by the ship, as computed by Captain Hosken, was 567 knots. The ratio of the speed of the ship, to that of the screw, during the entire voyage, was as ·887 to 1·; or in other terms the total slip was 12½ per cent. Considering then, that during the first 20 hours there was a strong gale and a head sea, and also, that in the run from the Downs to Blackwall, there was an exceedingly stiff head gale, while in the intermediate part of the voyage the wind was so light as to be of little service, this may be accounted an exceedingly favourable result.

The balance of tides was also considerably adverse.

The time the ship was under weigh was 59½ hours, so that the average speed was upwards of 9½ knots; and if allowance be made for times when, on account of the bearings becoming warm, the engines went slowly, the average speed may be fairly reckoned at 10 knots per hour.

Owing to the inefficiency of the stokers, the steam was not regularly or well kept up, and the pressure varied from 2 lbs. to 5 lbs., being frequently low. Duffryn coal was used, and all the ashes were burned. The throttle valves were kept more than one-half closed, and the expansion valves cut off the steam at one-sixth of the stroke, so that the economy of the fuel must have been very

		Revolution of Engines	Speed of Vessel in Knots.	
	H. M.			
Thursday, 23rd.	9 30 P.M.	10	6¼	Passed the Holms. Strong breezes from W.S.W. Hard squalls and rain.
Friday, 24th.	4 0 A.M.	9 to	..	Gale, with heavy squalls, and much rain.
	10 0 ,,	12	..	Abreast of Lundy. Wind shifted to N.N.W. with heavy squalls. High cross sea running. Ship taking in very little water.
	Noon .	13½	8½	Fresh gale with frequent hard squalls; very heavy cross sea running; ship rolling deep, but easy.
	3 20 P.M.	..	..	Strong ebb-tide. A very heavy sea struck the starboard bow, and drove in three 7-inch port-lights, and did some other slight damage to the upper works.
	4 0 ,,	13½	8½	Sea going down—ship going much easier. Set jib, square mainsail, and mizen spencer.
	7 40 ,,	14½	9¾	Sea going down fast; fine clear weather.
	8 45 ,,	15	10	Passed the Longships. Sea gone down. Sails of little use.
	10 40 ,,	15¾	10½	Off the Lizard. Sails no use,—fine weather.
Saturday, 25th.	2 45 A.M.	..	..	Eddystone Light being N.N.E. ½ E. Light air from the southward.
	5 15 ,,	16	10¾	Abreast the Start.
	9 45 ,,	..	..	Off Portland. Set square mainsail and all fore and aft sails.
	12 45 ,,	16	11¼	Passed the Needles.
	2 15 P.M.	..	..	Stopped three minutes off Cowes.
	3 40 ,,	15¾	10½	Passed the Nab light. Fresh breezes from S.W. thick foggy weather and rain.
	9 0 ,,	16	11¼	Beachy Head bearing North. In mizen and No. 3 spencer.
	11 30 ,,	..	..	Abreast Dungeness Light. Fresh breezes and fine weather.
Sunday, 26th.	1 45 A.M.	..	..	Came to anchor in the Downs.
	8 11 ,,	..	..	Weighed anchor and going.
	9 15 ,,	15¾	10¾	Abreast Margate. Stiff gale from W.N.W.
	12 30 P.M.	..	..	Came up with the *Waterwitch* steamer above the Nore, and passed her at the rate of 3 knots an hour.
	1 47 ,,	..	..	Very strong gale in the river right ahead. Gravesend Reach full of vessels,—steered in and out between them at full speed. Ran the measured knot in 6′ 16″, going 16 revolutions against a very stiff head gale.
	3 30 ,,	..	..	Moored at Blackwall.

considerable; but the men were too feeble to weigh the coal, and the arrangement of the indicators was not so far completed as to enable cards to be taken.

This account would not be complete without some explanation of the state of the ship, when she encountered the gale on Friday the 24th. The crew of sailors consisted chiefly of that indifferent class usually shipped for short runs, to whom of course the rig of the ship was perfectly new. Some of the engineers stood well to their duty, but others, and nearly all the stokers, were completely knocked up with sea-sickness. The deck was encumbered with at least 30 tons to 40 tons of chain cables and materials, and the coal was stowed chiefly in the upper bunkers, for the greater convenience of working it with so few men.

Consequently, with no weight in her bot-

tom, the centre of gravity was raised so high that the rolling, which was considerable, but very easy, is not surprising.

With the wind a head, or on either bow, and with a heavy head sea, she steered with the greatest ease and precision, and in the crowded river it was truly surprising how she threaded her way.

When the heavy sea before mentioned struck her, it caused no deviation whatever from the uniform motion of the engines, which went on as steadily as if they had been on land, neither was there the slightest yielding in the plummer-blocks, the frame, or in any part of the engines, or the engine-room, which is so riveted together, as to form one united frame.

On several occasions the author watched the screw, and he does not think it ever rose one-half of its diameter out of the water; and, standing by the engines during the worst of the gale, he could only observe that there was occasionally a slight acceleration, during perhaps half a revolution, but there never was any check to the uniform rate.

The paper is illustrated by seven drawings and diagrams, Nos. 3778 to 3784, showing longitudinal and transverse sections of the vessel and engines, with an elevation of the screw-propeller and diagrams of its angles of pitch, slip, &c.

Mr. Barnes confirmed the general statement of the results of the trial of the screw, which was lent to the '*Napoléon*,' the information having been, in fact, communicated by him to Mr. Guppy, immediately after trying the experiments. One point only required correction. The reason for the whole pressure of the steam not being applied, was not from a fear of breaking the screw, but because of its small dimensions, it having been made for the '*Archimedes*,' whose engines were 80 or 90 h. p., and more particularly on account of the pitch being so small. The result was, that when it was applied on board the '*Napoléon*,' the engines (which were 130 h. p.) would have required to have been driven at such an increased number of strokes, that the boilers could not have supplied sufficient steam. Even with the throttle-valve partially closed, great attention was required to keep up a steady speed.

He thought the results obtained, with such a small propeller, quite extraordinary, and such as could not have been anticipated.

He had since calculated the results more accurately, and found them as shown in the following table:—

Revolutions per minute.	Speed in knots.	First Mean.	Second Mean.
32·5 32·7 33·0 33 0	10·766 9·201 10 956 9·411	9·9835 10·0875 10·1835	10·031 10·132
Mean 32·8	..	..	10·0815

The speed of the screw of 7 feet 7¼ inches pitch was 10·7165 knots, which was in the ratio of 0·9047 to 1.

In his original calculations, given to Mr. Guppy, he had erroneously assumed the pitch of the screw to have been 8 feet.

The results of the indicator were	10·15 lbs. per square inch.
Deducting for friction, and more ample allowance than was required for engines in good order, which was not, perhaps, too much for engines which were quite new, and of which all the movements were stiff	1·55
Remains	8·60 = 95·5 h.p. for each engine.

Mr. T. R. Guppy stated, in answer to questions from the president and members, that during the whole voyage the throttle-valve was only one-third open, and that the steam was cut off at one-sixth of the stroke. It was not possible to take any accurate account of the coals consumed, but he estimated the consumption at about 40 tons in 24 hours. The screw propeller of the *Great Britain* was too small, but still the speed obtained even against a heavy head sea, was never below 5½ knots per hour.

Captain Hosken said, he considered it necessary to reduce the speed in heavy weather; it was in such cases dangerous to apply all the power of the engines; there was a danger of the sea making a clear breach over the vessel if she was driven bodily forward, instead of being allowed to rise with the waves. The experience he had acquired in the *Great Western* had clearly proved the correctness of his views.

His opinion of the advantage of the screw as a mode of propulsion was decided, and he thought that it would, for sea-going vessels, supersede paddle-wheels. During the worst part of the voyage, with the *Great Britain*, the screw was never more than one-half of

its diameter out of the water, and the other half was acting efficiently at the same time; whereas under similar circumstances, with such a cross sea, the leeward paddle-wheel would have been immersed, probably above its shaft, while the windward wheel would have been completely out of the water; the strain upon the engines, in such a case, was very prejudicial; but in the *Great Britain* he never noticed any variation in the working of the engines, not even when she was struck with the heavy sea which had injured the bow.

Captain Sir Charles Napier inquired, whether the *Great Britain* steered well, and whether it was not found she had a tendency to fall off to leeward in a cross sea? He should have supposed that the action of the screw propeller being so entirely in the stern, it would act upon the ship like sculling a boat.

Captain Hosken replied, that the *Great Britain* steered extremely well; and that there was not any tendency to fall off to leeward.

The action of the screw could not be correctly compared with that of a scull upon a boat; in that case, the power acted entirely upon the stern; but with the screw, the power was exerted in the direction of the shaft, up to the engines, in the centre of the ship, and by a simple arrangement it could be carried on even up to the bow. He was of opinion that the leeward paddle-wheel had not much power to keep a vessel up to the wind; it was so close to the ship's side that its leverage was not considerable.

Sir Charles Napier thought the principal danger of the screw propeller was in running before the wind in a heavy sea. If struck by a heavy wave, the sternpost and the propeller might be carried away together; as also in case of getting on shore, the screw would not be so efficient in clawing off shore as the paddle-wheels would be.

Captain Hosken said it was evident that the propeller was not easily injured, for since his arrival in the Thames he had found, coiled round the shaft, nearly 9 fathoms of chain cable, which had been apparently torn away from the mooring of a buoy, in coming up the river.

Mr. J. Miller said, one point of importance in favour of the screw was its not being affected by variations of immersion, arising either from the draught of water of the vessel, or from the rolling in a heavy sea. He had noticed particularly the difference of the speed of the engines, on board the Royal Mail Company's vessels, at the commencement and at the end of a voyage. At starting, with a full complement of fuel, the paddle-wheels were plunged so deep, that the speed of the engines, which ought on an average to be 17 strokes per minute, was reduced to 8 or 9 strokes, and at the end of the voyage the paddle floats had scarcely sufficient hold on the water. A vessel with a screw propeller would not be so affected.

He thought also, that the screw was less liable than paddle-wheels to be injured by heavy seas.

Captain Hosken was anxious to record clearly the points where he was satisfied the propeller was preferable to the paddle-wheel for steamers generally, but more particularly for the purposes of war and for Atlantic navigation.

By using the screw, a great weight was entirely removed from the top sides and centre of the ship.

The exertion of the power of the engines was transferred from the top sides and centre to the lower midship body, which was the strongest part of the ship.

There was a saving of nearly one-half the weight. In the instance of the *Great Britain*, that ship was first intended for paddle-wheels, which with all the appurtenances of beams, boxes, shafts, &c., were estimated at 180 tons. The weight of the propeller, the chain-wheels, shaft, chain, &c., might be taken at about 80 tons, and that weight was dispersed over nearly half the ship's length. When leaving port and the ship was deep, the propeller would exert its greatest power, when it was most required; paddle-wheels, on the contrary, when deeply immersed, would not allow the engines to exert their power.

A steam-ship, with a propeller, answered the helm quicker, and steered easier, than a paddle-wheel ship.

A great point, also, was the superior efficiency of a screw-propeller ship under canvas, on account of the absence of the unsightly and detrimental paddle-boxes; possessing also the advantage of the sails acting with the engines, instead of injuriously to them, as with paddle-wheels. When the sails took effect, the ship heeled, or inclined to one side, the paddle-wheels consequently became too deeply immersed on one side, and had not sufficient hold upon the water on the other, manifestly wasting the power of the engines.

The screw propeller was more easily disconnected from the engines than the paddle-wheels, should it be required to save fuel, or if the engines were disabled, and the ship being properly rigged, a decidedly efficient sailing ship still remained, which in a paddle-wheel ship was not possible.

The screw propeller was less liable to be damaged by heavy seas, or by shot, than paddle-wheels. Very recently, the West

India Royal Mail Steam-packet *Dee* had one wheel quite disabled, by a heavy sea striking it; while the screw was nearly always so immersed as to be out of the reach of injury, either from waves or shot.

As the relative merits of screw-propellers and paddle-wheels were of national importance, Captain Hosken felt confident no apology was necessary, for thus, as concisely as possible, giving his opinion before the Institution.

If he might recommend any points for the consideration of the Members, it would be that they should exert their ingenuity to discover the best propeller, all circumstances being considered; as in his opinion it would be very difficult, if not impossible, to find a propeller that should be the best under every variety of circumstance. He considered the best method would be to multiply or reduce the speed of the propeller, as might be found necessary under different circumstances, but that, he was aware, would, in very large steamers, be difficult of attainment.

Sir Charles Napier agreed with Mr. Miller with regard to the disadvantages of the deep immersion of the paddles, particularly those of war steamers, where wheels were constantly plunged too deeply when they had their full armament and fuel on board. For fifteen years past he had urged upon the Government the necessity of paying more attention to the construction of their war steamers; for, in his opinion, there was not one really good steamer in the service; and he thought the *Retribution*, which was the last vessel finished, was not any improvement upon its predecessors. He objected particularly to the present construction of direct-acting engines, by which the working parts were exposed to injury from shot. He thought, that all the upper parts of the engines, and the naves of the paddle-wheels, should be made of wrought-iron, as in the case of being struck by shot, less serious injury would ensue than when they were made of cast-iron.

He would suggest, also, whether it would not be possible to have tanks near the paddle-boxes, to be filled with water as the fuel was reduced in weight, and thus to keep the vessel at a uniform draught, so that the power of the engines could be always advantageously employed.

Captain Hosken said, in reference to the points suggested by Sir Charles Napier, experience had shown that anything cumbersome about paddle-wheels was bad for sea purposes, any machinery about them was difficult to be kept in order, and if the paddle-wheels were made to reef, when they were exposed to a heavy gale, or sea, they would assuredly lose a large portion of their paddle-floats.

The suggestion of a contrivance to fill water about the paddle-boxes, in proportion to the fuel consumed, so as to keep an uniform dip of float-board, appeared not only objectionable, but it amounted almost to an impossibility. It was scarcely possible, even if desirable, to find space for 500 tons of water in a steam ship that might take that quantity of fuel as her sea stock; and doing so, would keep the ship in a long voyage continually groaning under a heavy burthen. He agreed with Sir Charles Napier as to the desirableness of an uniform dip of the paddle-board if it could be obtained; but if it was only to be arrived at by always carrying a heavy weight, it was better to continue the present plan, of starting deep and arriving light.

Mr. Guppy said, in answer to questions from members, that, at present, he believed the average speed obtained by vessels with screw-propellers was below that of paddle-wheel steamers. A new screw of larger diameter and greater area of palms, was being made for the *Great Britain*, with a view to increasing the speed.

It should not be forgotten, in the discussion, that a distinctive feature of iron vessels was their stiffness, and he conceived they were better calculated to withstand the shock of heavy seas than wooden vessels were.

Four chains, weighing together about seven tons, were employed for communicating the power from the upper drum, upon the main shaft, to the lower drum upon the shaft of the propeller. They worked smoothly and without noise, and at present had not shown any tendency to wear, or to lengthen. From the form of the link, he conceived that the chains would only lengthen on the slack side, under any circumstances; and this would not affect their working, as the projecting ends of the links would, on the driving side, always fall into the recesses prepared for them, so that these recesses must be much worn, before the chains would ride out of their proper direction upon the drums.

(To be continued.)

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1153.] SATURDAY, SEPTEMBER 13, 1845. [Price 3*d.*

Edited by J. C. Robertson, No. 166, Fleet-street.

THE ATMOSPHERIC RAILWAY SYSTEM.

Fig. 1

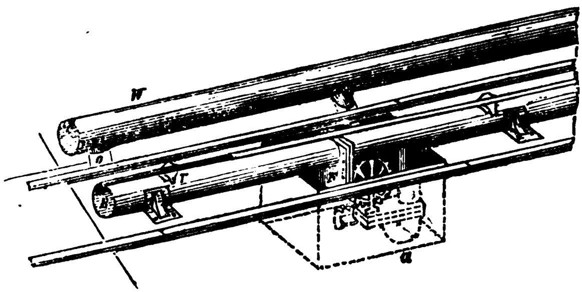


Fig 2.

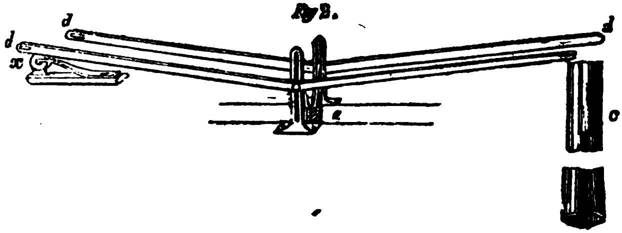


Fig 3.

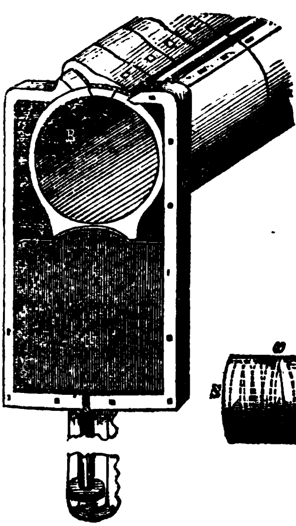
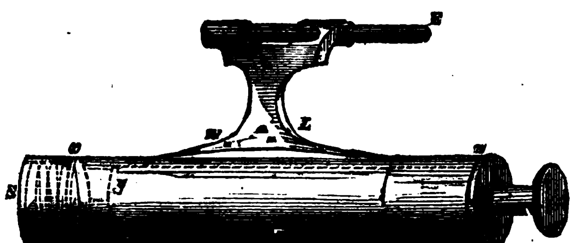


Fig 4.

Fig 5.



THE ATMOSPHERIC RAILWAY SYSTEM—IMPROVED PLAN.

Sir,—I beg leave to forward for insertion in your pages (if acceptable) a plan for an atmospheric railroad, which seems to promise all the advantages of a locomotive railway, with more than its ordinary safety.

I am acquainted with Mr. Pilbrow's plan, as far as your work gives it; but I must acknowledge I cannot perceive what is to prevent the piston outstripping the loaded carriages. The Dalkey Railroad, I think, possesses no arrangement for crossing on the level, nor any that allows of the trains stopping at intermediate stations, or going the whole length of the line without stopping, and in either case of travelling without attention from any party but the conductor. The "hot iron" of the Clegg and Samuda system is certainly no recommendation; and if it could be dispensed with, there would, doubtless, be a great advantage gained.

I remain, yours respectfully,

B. C. G.

Description.

It is proposed to have one centre main exhausting tube, for the whole length of the line, or such length as the power of the stationary engines will admit of, &c. The working tube to be in sections, as required, and connected with the main as shown in the sketches.—W is the main; *o*, the main continued under a roadway; B, the working tube; F, sliding valve, shutting off communication with the atmosphere; while, at the same time, by means of the wheel R, the valve G opens a communication with the main exhausting tube, W, through the connecting pipe *a*. At a proper part on each side of the leading carriage would be fixed the wheels X, to travel the slides *d d*, (the ends, *d d*, being on their centres at fig. 1, *r r*,) thus raising the rack *e* upon the wheel R, as required, to act upon the valves F and G.

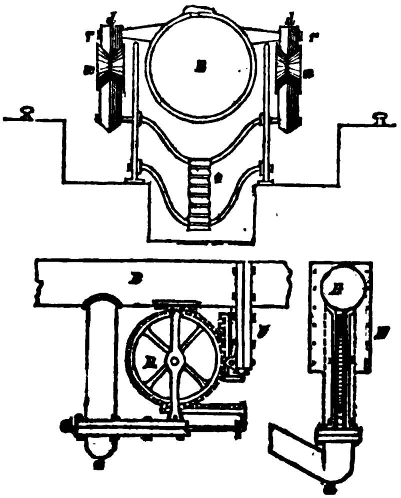
Fig. 3 is an inside view of the valve F; H is a plate, ground true on one side, to slide over the opening upon the leather I, (which might be united to the casting by india rubber) and not quite flush with the inside of the tube. The top, *v*, of the plate H, is intended to fit close under the leather of the long valve.

Fig. 4 shows the long valve raised by the piston slide L.

Fig. 5 is a side view of the piston, and the slide L, which is intended to lift the valve; showing also the place of connexion, E, with the carriage. It will be observed, that should any accident prevent the opening of the valve H, the carriages would proceed notwithstanding, without the possibility of incurring any damage. Any shock that might arise from the percussion of the piston against the valve, as it is but a light weight, would be obviated by a spiral spring inside the hollow piston. To ensure the safe passage of the piston from one section to the other, it is proposed to enlarge the ends of the tubes, say to 4 in. inside diameter more than the size of the piston, as shown in fig. 2, and gradually to decrease the diameter until it assumes its proper size, and fits the piston, &c. a short distance before the longitudinal valve commences at C, fig. 1 and 2; which valve is continued some 6 or 8 feet, unconfined by any pressure of the atmosphere, till it reaches the section valve, thus permitting an easy entrance for the piston slide under the long valve, and providing against the ingress of air in front of the piston at the opening of the section valve. The long valve may be effectually protected from the weather by a kind of tarpauling cloth, as indicated by the dotted line, fig. 4. The other valves are necessarily protected by their peculiar construction.

All being thus secured from injury by the weather, there does not appear anything to prevent them from wearing well—if they can be made air-tight. Some good self-lubricating plan would probably effect that object,—and under that idea, it is proposed that soft grease should exude from conveniently-sized holes, *n n*, round the fore part of the piston, and on both sides the piston slide, as shown at one side marked *n n*. The hollow piston being provided with another hollow cylinder inside, as far as *y*, and the space between the two, holding the lubricating matter, a piston, *v*, aided by a slight spiral spring at *s*, so that the matter may be kept up to the surface, the frictional demand would induce the required supply. By this means it is supposed that the tube and valves would be sufficiently and equally greased; for the suction and connection valves, when once done, would supply themselves by their own action from the waste from the tube. Thus the long valve, by bearing on the convex edge,

and the other valves sliding only on smooth and level surfaces, and not being liable to derangement from the action of the atmosphere, and all being luted (as it were) by the constant supply of the soft grease, it may be supposed they would be very tolerably air tight.

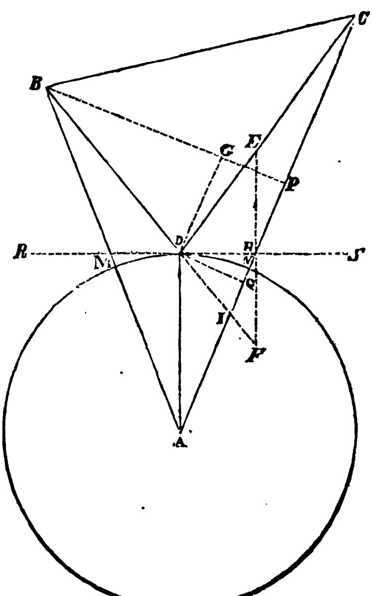


This plan admits of letting in air in front of the piston, to moderate the speed when required to stop at a station or otherwise; and it will be evident, that by this plan the working tube may be discontinued in the immediate vicinity of any station, to admit of any additional rails and deviations from the main line as the case may require; in that case, the sections would not be farther apart than the motion acquired in one section would enable the train to reach the next.

THE CASE IN RAILWAY ENGINEERING (PAGE 111.)

It appears from the conditions of the problem, that the distance of the town A from the station of supply at D, is given in magnitude, but not in position as regards the direction of the distances from A to B, and from A to C respectively; for it is stated in the enunciation, that the engineer was at liberty to lay it down in any position he pleased, limited, of course, to the angle contained between the direct distances of A from B, and of A from C. From this we infer, that the station D is situated in the circumference of a circle, of which the centre is at A and the radius the direct distance from A to D. This inference leads us directly to the method of resolving the problem; for it is a well-known principle in geometry, that when two straight lines are drawn from two points any how placed without the circle, to another point in the circumference, the sum of these lines is a minimum, when they make equal angles with the tangent at the point of concourse, and as a consequence, with the radius of the circle to which the tangent is drawn.

With the three given distances construct the right-lined triangle A B C, making A B = 25 miles; A C = 31 miles, and B C = 22 miles; then with the radius A D = 12 miles and centre A, describe the circle M D N. Let D be the point in the circumference sought, and through the point D, draw the tangen R D S, intersecting the distance A C in the point H. From the given points B and C to the point of contact D, draw the straight lines B D and C D; then if the angles B D R, C D S, or A D B, A D C,



are equal between themselves, the straight lines D B, D C, when taken conjointly, shall be less than if they were drawn to any other point in the circumference;

this, therefore, is the condition that the problem requires to be satisfied.

From the point B let fall the perpendicular B P, meeting A C in the point P, and through D draw D Q and D G respectively parallel to B P and A C; so shall D G be perpendicular to B P and D Q to A C. Through the point H, where the distance A C is intersected by the tangent R S and parallel to the radius A D, draw the straight line E H F meeting B D produced in F; then from the figure thus constructed are the principles of solution to be deduced.

Since the straight line B P is perpendicular to A C, we have by the property of the triangle,

$$AB^2-BC^2=AP^2-CP^2;$$

from which equation the segments A P and C P can readily be found, we therefore consider A P as known. Because the straight line H E is parallel to the radius A D, the triangles A C D and H C E are similar to one another; and because the straight line D F, which is the production of B D, falls upon the parallel lines A D and F E, it makes the alternate angles A D F and D F E equal between themselves; but the angles A I D and H I F, are equal, being opposite angles; consequently, the triangles A I D and H I F are similar to one another. Therefore, by the property of similar triangles we obtain the following analogies, viz., from the first pair of triangles A C D and H C E, it is

$$AC : AD :: HC : HE;$$

and from the second pair, viz. A I D and H I F, it is

$$AI : AD :: HI : HF.$$

But H E and H F are obviously equal, for the angle F D H is equal to the angle B D R, being opposite angles, and by the nature of the problem, the angles B D R and C D S are equal; therefore, the angle E D H is equal to the angle F D H and D H is common to the two triangles E D H and F D H, so that H E and H F are equal; from this it follows, that there is an antecedent and consequent, the same in each of the foregoing analogies, and by expunging those terms, the remaining ones, by the comparison of ratios, give

$$AC : HC :: AI : IH;$$

from which, by composition, we obtain

$$AC+HC : AC :: AI+IH : AI.$$

Since D Q is perpendicular to A C, and A D H a right angle, the triangles A D Q and A H D are similar; from which we obtain

$$AQ : AD :: AD : AH=\frac{AD^2}{AQ}.$$

And moreover, because the straight line D G is by construction perpendicular to B P, and D Q perpendicular to A C, or parallel to B P, the triangles B D G and D I Q are similar; hence we get

$$BG : DG :: DQ : IQ=\frac{DG\times DQ}{BG}.$$

But B G is manifestly equal to the difference between B P and G P, or between B P and D Q; that is, B G=B P−D Q; and furthermore D G=A P−A Q; therefore, by substituting these values of B G and D G in the above expression for I Q, we obtain

$$IQ=\frac{DQ\,(AP-AQ)}{BP-BQ}.$$

Now A I is equal to A Q−I Q; that is,

$$AI=AQ-\frac{DQ\,(AP-AQ)}{BP-DQ};$$

and H C is equal to A C−A H; that is,

$$HC=AC-\frac{AD^2}{AQ}.$$

Let these values of A I and H C be substituted instead of them in the analogy obtained by composition, and it becomes

$$AC+AC-\frac{AD^2}{AQ} : AC :: AQ-\frac{DQ\,(AP-AQ)}{BP-DQ}+IH : AQ-\frac{DQ\,(AP-AQ)}{BP-BQ}.$$

In order to simplify the succeeding steps of the investigation, and to avoid confusion in the result, it becomes necessary to substitute symbols for the several quantities or lines in the figure; and for this purpose,

Put b=A C, the greatest distance, or base of the triangle A B C;

d=A P, the distance from the centre A to the point where the perpendicular B P meets the base A C;

p=B P, the perpendicular from the angle B on the base A C;

r=A D, the radius of the circle, or the distance from A to the station of supply at D;

x=A Q, the abscissa, or distance from A, where the perpendicular from D meets the base A C;

And y=D Q, the ordinate or perpendicular from D on A C.

Then, by substituting each of these

symbols in the above analogy for the particular parts of the figure that they respectively represent, we shall have

$$\frac{2bx-r^2}{x} : b :: \frac{r^2}{x} : \frac{px-dy}{p-y};$$

and this, by equating the products of the extremes and means, becomes

$$\frac{(2bx-r^2)\ (px-dy)}{p-y}=br^2,$$

from which, by expansion, we obtain

$$2bpx^2-pr^2x-2bdxy+br^2y+dr^2y=bpr^2.$$

Now this is evidently an equation belonging to a conic section; and by calling to mind the nature of these curves, we find it to be the equation of a hyperbola between the asymptotes. Consequently, if this hyperbola be constructed according to the rules laid down for that purpose by the writers on conic sections, one of its branches will intersect the circle in the point D. It would, however, render the figure by far too complicated to show the method of construction in this place; we shall therefore omit it, and proceed to determine the things required by means of the equation alone.

In order to eliminate y from the above equation, we must endeavour to express it in terms of x and known quantities, and by referring to the figure, it will readily be perceived how that is to be done; for, by the property of the right-angled triangle, we have

$$\text{A D}^2=\text{A Q}^2+\text{D Q}^2;$$

that is, $r^2=x^2+y^2$; consequently, by substituting in this equation the square of the value of y deduced from the preceding one, we get

$$x^2+\frac{4bp^2\ (bx^4-r^2x^3-br^2x^2)+p^2r^4\ (b+x)^2}{4bd\ (bdx^2-br^2x-dr^2x)+(b+d)^2r^4}=r^2;$$

an equation of the fourth degree, having all its terms, and in order to prepare it for solution, we must restore the numerical values of the several quantities which it contains.

From the expression

$$\text{A B}^2-\text{B C}^2=\text{A P}^2-\text{P C}^2$$

we get A P$=d=17{\cdot}7742$, and

$$\text{B P}^2=p^2=309{\cdot}0778;$$

consequently, by introducing these numbers, together with the values of b and the powers of r, as expressed in the equation, it will be found, after reduction, that one of the roots or values of x is equal to 11 very nearly. Taking it at 11, to avoid fractions, and simplify the calculation, we shall have D Q$=4{\cdot}7958$; therefore, by trigonometry, we get

$$\text{A D : A Q :: rad. : sin. A D Q};$$

that is, 12 : 11 :: 1 : 0·91667, which corresponds to the sine of 66° 27′ very nearly. Since A Q$=11$, and A C$=31$, it follows by subtraction, that C Q$=20$; and by trigonometry it is

$$\text{D Q : C Q :: rad. : tan. C Q D};$$

that is, 4·7958 : 20 :: 1 : 4·17029, which corresponds to the tangent of 76° 31′, taking it to the nearest minute. Therefore, by addition, it is

$$\text{A D C}=\text{A D B}=66^\circ\ 27'+76^\circ\ 31'=142^\circ\ 58',$$

the angle of direction sought.

To find the distances D C and D B, it is sin. 76° 31′ : 20 :: 1 : C D$=20{\cdot}5669$ miles; and again we have

$$25 : \text{sin. } 142^\circ\ 58' :: 12 : \text{sin. } 16^\circ\ 48'=\text{angle A B D};$$

Hence again it is sin. 16° 48′ : 12 :: sin. 20° 14′ : D B$=14{\cdot}3586$ miles; and the sum of the two distances is 34·9255 miles.

Some of our readers will probably recognize in the above problem the one which was proposed by Alhazen, the celebrated Moorish astronomer, and which was solved in all its cases by the French nobleman, the Marquis de l'Hospital. We believe that the above solution is drawn out on principles something similar to those employed by the Marquis; but our recollection of the subject is not sufficiently vivid to pronounce it identical in that respect.

We do not presume to say that the several results are rigorously correct, the numerical co-efficients being so complicated, and the quantity of calculation so great, that verification was wholly out of the question; the errors, however, if any exist, will, it is hoped, be found very trifling.

DESCRIPTION OF THE GREAT BRITAIN IRON STEAM SHIP, WITH SCREW PROPELLER; WITH AN ACCOUNT OF THE TRIAL VOYAGES, BY THOMAS RICHARD GUPPY, ESQ.

[From the Proceedings of the Institution of Civil Engineers.]

(Concluded from page 176.)

MR. R. STEPHENSON observed, that the chains very nearly resembled those used in the early locomotive engines, and which were discarded on account of their lengthening so much as to render them useless. It was true, that the links of the locomotive chains were much smaller, there were many more traversing pins, and the speed at which they travelled was probably greater than the large driving chains of the *Great Britain*, which would, therefore, be less liable to injury than those he had mentioned.

Sir JOHN RENNIE, *President*, said, that the Institution was much indebted to Mr. Guppy for the paper which had induced, in the course of the discussion, the expression of the opinions of the good authorities who had spoken on a subject of such great importance.

The advances made in steam navigation were already very great, but he anticipated much greater would result from the application of the screw-propeller. The best forms, not only of propellers, but of the vessels to which they could be most advantageously applied, would be more accurately ascertained from the experiments now in progress, by the order of the Government, and also by private individuals; he hoped the Institution would soon be put in possession of the result of these, by the same spirit of liberality as had induced Mr. Guppy to present his paper.

A very interesting communication might be produced, by tracing the progress of steam navigation for the last few years, taking, for instance, one station; that of Dover, where, it would be recollected, with the old vessels eight or nine knots an hour was considered a good speed, but at present, with better-shaped vessels and more powerful engines, a speed of nearly 15 knots per hour was stated to have been attained.

Mr. P. TAYLOR said, that great difference of opinion existed among the officers of the French navy as to the capabilities of the *Napoléon*.* It had been asserted, that with the peculiar build and great proportion of power to tonnage of that vessel, greater speed should have been attained. Mr. Taylor was not of that opinion, although he fully appreciated the build of M. Normand's vessel, and the excellence of Mr. Barne's engines. He had paid much attention to the result of the voyages of the *Napoléon*, and found them, on an average, more rapid than those of the paddle-wheel vessels on the same station. The screw did not generally make such good way in smooth water; but with a sea or wind sufficient to lay a paddle-wheel ship at all over, the screw gained immensely, and hence its average superiority.

After the trial voyages, and the run from Havre to Marseilles, with the cast-iron screw, which had been mentioned at the Institution on a previous occasion, it was found, on putting the *Napoléon* into the graving dock at Toulon, that the outer journal of the propeller-shaft was much worn, and that the cast-iron screw was much affected by galvanic action; a new bronze screw was therefore cast, and was highly polished and varnished before it was fixed. At the same time the bearing areas of both the outer and the inner journals of the shaft were increased, and a jet of cold water was arranged so as to be constantly applied to them. Since these alterations, there had not been any undue wearing of the journals.

Mr. BARNES would not venture to state the relation of power to tonnage on board the *Napoléon*, as the methods of measurement of vessels were quite illusory. The engines were 130 h. p. The vessel was 148 feet 6 inches long, and 27 feet 4 inches broad at the water line, drawing 11 feet 10 inches aft, and 7 feet 5 inches forward, and the area of the midship section at that draught was 144 square feet. By the ordinary rules of measurement, the tonnage would be 490 tons, and the displacement, 365 tons.

He had made many engines for vessels built by M. Normand, and he knew their capabilities. He was of opinion, that if the feathering paddle-wheels, invented by M. Cavé, had been adopted to the *Napoléon*, as good speed would have been attained, as with the screw, in all weathers; but that with the common paddle-wheels such results could not have been arrived at.

Mr. F. P. SMITH had found, with reference to the journals of the propeller-shaft, that steel was the best material for the bearing of the toe or extreme end, where the destruction was most rapid, and that the best form was that of two hemispheres, working under a constant jet of cold water. The experience upon the *Rattler* tended to show, that it was advantageous to reduce the bearings as much as possible; for they had always worn down to certain dimensions, and then had ceased to wear. On the contrary, however, on board the *Great Britain* and the *Napoléon* it appeared, that an increase of the size of the journals had been advantageous. On this practical question, the manner in which the thrust of the propeller-

* The dimensions and particulars of the *Napoléon* are given in the Minutes of Proceedings, 1844, p. 79.

shafts was received in the toe bearing must be well considered, before any rule could be laid down.

As had been previously stated, one of the chief merits of the screw was its permitting such an advantageous use of the sails. In the *Rattler* it was found, that when with steam alone the vessel was running 9¼ knots to 9½ knots per hour, and the engines were making 26 to 26½ strokes per minute, on the sails being set the speed increased to 12 knots and the engines made freely 28½ strokes. At that rate it was supposed the screw was dragged through the water; but on applying the dynamometer it was found, that the forward thrust of the shaft was the same as before the sails were used. The screw was, therefore, producing its full effect. If the sails had been set on a paddle-wheel vessel, under similar circumstances, the lee wheel would have been so much depressed as to have impeded the progress; and the windward wheel would have lost a considerable portion of its effect, owing to the heeling of the vessel. To that cause must be attributed the fact of the Royal yacht gaining speed in proportion as it shortened sail, with the wind on the beam.

In the recent trial cruise, while rounding the *Longships* against a heavy head sea, the *Rattler* did not make good way. The vessel pitched so, that the propeller was frequently more than half its diameter out of the water. On trying the dynamometric effect, it was ascertained that the power was fully expended, but that it was insufficient for the tonnage of the vessel, whose build also was not calculated for speed. In rough weather, with a head wind, the rigging was a serious impediment to speed, but with the wind a little abaft the beam, it was thought that, in spite of her build, the *Rattler* would prove herself fully equal to any vessel of similar power and tonnage.

From his previous experience of the performances of the *Rattler* in smooth water, Mr. Smith had recommended to the Admiralty that a larger propeller should be tried. The recent trials at sea had proved the correctness of the recommendation, which was now been acted upon.

Captain Crispin corroborated Mr. Smith's statement, relative to the Royal yacht. With the wind on the beam, owing to her heeling over, the lee wheel was so much plunged as to materially reduce the speed of the engines and of the vessel, and the more the sails were reduced, so as to bring her upon an even keel, the faster she overhauled the *Rattler*, whose engine power he considered insufficient for the tonnage; whilst the superior size and power of the yacht enabled her to make good way against a heavy head sea. The performance of the *Rattler*, with the wind on the beam, and the canvas set, surprised all the officers of the squadron.

Mr. F. P. Smith repeated, that in his opinion the screw was preferable to paddle-wheels under all circumstances; but it was in a rough sea, in combination with sails, that its merits were most apparent.

In going down the river with the *Archimedes*, he had repeatedly been passed by merchant steamers; but by the time he had reached Dungeness, the *Archimedes* had fetched up the loss, and was some distance a-head of the other steamers.

With a propeller of two arms, he had found, that if, instead of disengaging the screw and letting it run loose, the arms were fixed vertically with the stern-post, the *Archimedes* would make, under sail, from 9 knots to 9½ knots per hour.

The propeller formerly used on board the *Rattler* was 10 feet in diameter, with two blades one-eighth part of the disc, and that now used was of the same diameter with the blades of two-sixths of a disc.

The speed was ascertained by the common and by Massey's patent log, carefully thrown, and attended to by the officers.

Mr. J. G. C. Curtis remarked, that it was necessary to be extremely cautious in using the results of the ordinary log; for although very useful for the common purposes of navigation, he did not think they ought to be allowed to enter into the computation of a vessel's velocity, where the "slip of the screw" was to be determined.

Mr. Curtis having been employed under Sir Edward Belcher, in his surveys in the Pacific, when the distance run by the vessel had to be determined with the greatest precision, might, perhaps, be permitted to make a few remarks on this subject.

The velocity of a ship being determined with the ordinary log, by ascertaining how much of the line, attached to the log, ran out in a given time, it was essential that both the time and the distance should be correctly measured; but that was seldom the case, as the sand in the sand-glass, which measured the time, was affected by every change in the atmosphere, and the line which measured the distance was alternately wet and dry, and being stretched unequally, at different parts, it was impossible that the marks, or knots, could remain at the distances which they were intended to indicate. These difficulties, when the vessel was going less than eight or nine miles an hour, might be partially surmounted, by counting the requisite number of beats of a good watch, instead of using the sand-glass, and by actually measuring the quantity of line which ran out, instead of counting the distance by the knots.

But in heaving the log at higher rates, it

was difficult to prevent the log from being dragged after the ship by the friction of the reel; and whether the line was "taken off" or "paid out," there was always a degree of doubt whether the correct length had been allowed to go off the reel.

It was also nearly impossible to measure the time to the requisite degree of accuracy, by the 14 seconds sand-glass, which was generally used at high rates.

For instance, if a vessel were going 14 knots, the quantity of line representing one mile passed through the hand of the observer in one second of time; and hence, in order to obtain the speed to the eighth part of a mile, it would be necessary to measure the interval to the eighth part of a second. In like manner, to obtain a vessel's speed to the eighth part of a mile, when she was going 10 knots, it would be necessary to measure the interval to the sixth part of a second.

As these small portions of time could not possibly be measured by a sand-glass, persons unacquainted with the subject would not be surprised to learn, that Mr. Curtis had heard it expressed as an opinion, by most naval officers, and had found by his own practice, that the rate of a ship going more than 10 knots could scarcely be obtained within a mile, under favourable circumstances.

As Mr. Curtis was convinced that the difficulty of accurately measuring the speed was one of the greatest causes of the discrepancies which existed in the accounts of the trials of vessels, he ventured to suggest an expedient "for determining a vessel's velocity at any given instant," which he thought would be more accurate than the common log. He proposed that the time which a vessel took in passing through her own length should be measured; from which her velocity per hour could be easily ascertained by proportion.

For this purpose he would fit, in convenient places, at a short distance from either end of a vessel, two rods, one vertical and the other horizontal, so that each pair, when seen in coincidence, should point in a line perpendicular to the direction of the vessel's keel. He would also have a buoy painted white and black, or any colours that would show well, when in the water; to this he would attach a line considerably exceeding the length of the vessel.

This buoy should be passed forward, with plenty of spare line, to the bowsprit end, the end of the line being made fast abaft, ready to haul it in when done with.

When these preparations were complete, he would stand at the foremost pair of rods, with an assistant at the after pair; he would then direct the buoy to be hove overboard, as far out from the vessel as possible; as it passed his own rods, he would commence counting the beats of a good watch, until his assistant, by holding up his hand, or giving some other signal, indicated that it had passed the after rods; and then the calculation was easy. The number of beats counted was to the number of beats in an hour as the distance between the rods was to the velocity per hour.

In a vessel like the *Great Britain*, where the length was one-nineteenth of a nautical mile, the method proposed would possess great advantages over the common log, particularly at high velocities; and in practice the method would be very easy, as a table might be made of the velocity, corresponding to a given number of beats, and in smooth water, a good-sized chip, or a bottle, might be thrown overboard, and would save the trouble of hauling in the buoy.

Captain Hosken could not agree with Mr. Curtis as to the general incorrectness of observations by the log. He was convinced that with a correct glass, and a log properly "hove" by an experienced seaman, the distance would be given to one-eighth of a mile. Under all circumstances, he thought the common log was the best known means of ascertaining the speed at sea. "Massey's" log was, perhaps, the best of all the other instruments he had seen and tried. When a vessel was going less than 5 knots, it did not indicate sufficient distance; between 5 knots and 8 knots it was very correct; but above that speed, it again gave insufficient distance. He had Massey's log overboard from the *Great Western* all the way from New York to Bristol, when the distance shown was about 200 miles less than the ship had actually run. The average speed on that occasion was about 10 knots per hour. He however thought that Massey's log was an excellent guide for running channel distances in the night, or in thick weather.

Sir John Rennie, *President*, directed attention to a remark made by Sir Charles Napier, as to the relative powers of vessels with screw propellers, and with paddle-wheels, for clawing off a lee-shore.

Mr. F. P. Smith was of opinion, that if a vessel with a screw used her canvas, as well as the propeller, she would claw off quite as well, if not better, than a paddle-wheel steamer, as from the heeling of the vessel the lee paddle would thereby lose much of its power.

Captain Hosken thought that a screw would make less lee-way than paddle-wheels, and would be quite as effective in clawing off. The American steamers had their paddle-wheels driven by separate engines, and had of course the advantage of being able to turn a-head on one side, and astern

on the other. Even that, however, was not very effective; and of course was not applicable to a sea-going steamer, in which disconnected engines and wheels would be, practically, very dangerous.

Mr. F. Braithwaite said, that Captain Hosken's remarks on American steamers induced him to ask, whether there was any provision on board the *Great Britain* for disconnecting the engines from the screw, and in how short a time it could be done? Some very good methods of disconnecting had been designed and put in practice by Messrs. Maudslay and Field, and by Messrs. Seaward; and he understood that the system had been advantageously applied on board some French steamers. Two steamers recently on their passage from France to Algiers, with a fair wind, afforded a good example. One of them, being able to disconnect the paddles, and use the sails, saved half the fuel, and arrived within a few hours of the other that had steamed the whole distance. He believed that only about half a minute was occupied in disconnecting.

Mr. Guppy explained that, on board the *Great Britain* the means of disconnecting the screw was by taking out four screw-bolts, and drawing back a coupling-box, which occupied about a quarter of an hour, during which time the engines must be stopped. He considered it hazardous, with such powerful engines, to have any means of disconnecting which might be used while the machinery was in motion.

Mr. F. Braithwaite must contend that, under certain circumstances, it was very advantageous to have the power of disconnecting rapidly. The *Phœnix*, a vessel built by Messrs. Scott and Sinclair (Greenock), struck, and sprung a serious leak; and when it was found that the hand-pumps could not gain upon the leak, the paddles were disconnected, and all the power of the engines being applied to pumping, she was kept afloat and was saved.

Mr. John Scott Russell corroborated the statement as to the *Phœnix*. The coupling alluded to was very efficient and safe.

With respect to the value of the lee paddle; he thought it of little use, even if the windward paddle could be disconnected. In some experiments on the subject, he found that a vessel using her power upon both wheels could be brought round in two minutes, and when using only one wheel, three minutes were occupied in bringing her round; proving that the diminution of speed by the loss of one wheel was more than equal to the effect of the disconnected wheel. There were instances of vessels having one wheel disabled, and finishing their voyage with the remaining wheel, without much inconvenience in steering.

An instance was recorded of a steamer, commanded by a good seaman, though but little accustomed to steam navigation, getting his vessel into the trough of the sea, in very heavy weather, and being entirely unable to bring her head to windward, until the mate suggested reversing the engines; by which means she was easily brought up, and afterwards made her passage safely.

Captain Hosken stated, in reply to a question from the President, that he thought the *Great Britain* would not be more liable than other ships to "broach to" when scudding. His opinion was founded upon experience in the *Great Western*. The same question had been put to him by old seamen, before the first voyage of that vessel, when, from that ship's great length, it was thought there would be more than usual difficulty in steering her: Captain Hosken differed from the general opinion; and time had clearly shown that he was right, as she scudded and steered as well as any, and better than most other ships. The *Great Western* was as great an increase in size when she was built as the *Great Britain* was now; and he felt confident that ship would prove as triumphant a specimen of naval architecture.

Scudding well was a point of great importance, and was entirely a seaman's question. No point required more judicious management and correct judgment than as to when a ship could not scud longer with safety, and ought to be "hove to."

He had very often, in the *Great Western*, been scudding past very fine ships of from 500 tons to 1000 tons, not very deep in the water, "laying to," because they could not scud with safety.

There were now several steamers longer than the *Great Western*, and he had never heard that any difficulty had been experienced with them on this important point.

So far as he had the opportunity of trying, he would say most decidedly the *Great Britain* steered easier and better than the *Great Western*; and he was sure he could not find a better ship to compare with, either in the naval or mercantile service.

Mr. Pim mentioned an advantageous application of the combined power of the screw and sails, which had been practised by his relations, Messrs. Pim, of Hull. They had adapted to two fine trading schooners screw propellers, driven by small engine power. The result of this experiment had proved that, in cases where extreme speed was not an object, but in which regularity was essential, this plan might be advantageously adopted; especially for commercial purposes, in which it was requisite to combine economy and a certain amount of dispatch.

The vessels he alluded to were very seaworthy boats; and on one occasion, when on a voyage to Dublin, the *Shannon*, a large merchant steamer, had been obliged to run for shelter, one of these vessels had rode out the gale, and made her passage. He believed that they were propelled by Mr. Smith's screw, and that he could give all the particulars of their construction.

Mr. F. P. SMITH said the vessels alluded to were the *Margaret* and the *Senator*, trading from Hull. They were fine four-masted schooners, of 242 tons burthen; each vessel had on board two engines, severally of 14 horse-power, placed as close as possible to the screw propeller, which was driven by gearing. The total weight of the engines, screw, and tubular boilers with their water, was 15 tons, and they worked under a pressure of 8 lbs. to 10 lbs. of steam.

In a trial between one of these vessels and the *Shannon* steamer, it was found that, between Dublin and London, the *Shannon* consumed 90 tons of fuel, while the schooner, with 300 tons of cargo on board, only used 18 tons of coal, and arrived in London within 10 hours after the *Shannon*. In an experiment with the *Senator*, with 172 tons of cargo on board, when steaming only, the rate through the water by the log was 6½ knots; and with sails and steam the rate was 9½ knots to 10 knots. It was remarkable that this increase of speed did not appear to augment the consumption of fuel; whereas with paddle-wheels and sails the consumption of fuel increased in proportion to the rate of the vessel through the water.

Captain HOSKEN could not permit the discussion to terminate without stating that in his opinion, as a naval officer, one of the great merits of the screw as a propeller was its capability of being adapted to a full-rigged ship, using at times her canvas as usual. The British seamen would thus be fully as much employed as heretofore, and they would retain that superiority which had so largely contributed to the high position held by Great Britain in the scale of nations.

Mr. J. FIELD, *V. P.*, said he had received a communication from Lady Bentham, relative to some of the improvements in naval architecture, introduced by the late Sir Samuel Bentham, which appeared to be so interesting that, with the permission of the President, he would request a portion of it might be read to the meeting.

The communication commenced by stating that, as in the paper on the construction of the *Great Britain*, particular stress was laid upon the advantage of fixed water-tight bulk-heads, dividing the hold into several compartments, the merit of the first introduction of that great improvement in naval architecture must be claimed for Sir S. Bentham: it then proceeded,—

"On reference to his Naval Papers, it appears that in the year 1795, he was entrusted by the Lords Commissioners of the Amiralty to construct six vessels of war, according to his own ideas and under his direction, at Redbridge. In the Naval Papers, No. 8, part 8, 'Improvement in vessels of War,' a short communication is given of the several expedients he introduced into them, with a view to strength, durability, efficiency, and diminution of cost; (page 91,) it appears that he had introduced in those vessels 'fixed bulk-heads, or partitions formed in a manner calculated to contribute to strength, both in the transverse and longitudinal directions; that they comprehended in their construction diagonal braces, at the same time that they served as partitions for the convenience of habitation or for the separation of stores;' that they connected the bottom, sides, and decks together, so as to prevent their racking or working at sea; that 'a farther use of these partitions was, that having been made water-tight, as practised by the Chinese of the present day, as well as by the ancients, they tended to secure the ship against foundering, by confining the water from a leak to the space between two partitions.'

"Again, (page 99,) amongst the various expedients enumerated, as tending to diminish the danger of material injury or the loss of a ship in case of her striking the ground, it is stated, that "the interior of the vessel having, as above-mentioned, been divided into several water-tight compartments, it is not even the flowing of water freely into one or two of these compartments that would endanger the loss of the ship.

"So also in 'The Elements and Practice of Naval Architecture' (page 177, third edition,) in giving an account of the above-mentioned vessels of Sir Samuel Bentham's construction, the author says, 'the mode of structure of these vessels is very different from that of others;' and after mentioning various particulars, says, 'but the principal strength seems to depend on the thwartship braces and bulkheads, which connect the sides together more conformable to the practice of civil architecture.'

"Besides these fixed bulk-heads, the metallic water-tanks (invented by Sir Samuel Bentham for the preservation of water), were, on board these vessels, 'so contrived that their fore and aft partitions, extending in height from the bottom of the ship to the deck, operated as supports to both bottom and deck.'—Naval Papers, No. 8, page 108. So also 'the metallic canisters for keeping powder were adapted to the shape of the vessel.'

"It may be added, that other of the improvements introduced, I understand, in the *Great Britain*, had, as well as the water-tight compartments, been half a century ago exemplified in Sir S. Bentham's vessels; such as the tumbling-out of the topsides and the straight decks.

"The above-mentioned work, 'Elements and Practice of Naval Architecture,' and Sir S. Bentham's 'Naval Papers,' Nos. 2, 7, and 8, record the extraordinary strength and efficiency of his vessels, as well as a variety of peculiarities in their construction, whereby that strength was given, with about half the quantity of timber used in the customary mode of construction, and only one-sixth part of the copper was used for fastenings.

"This statement cannot in any way detract from Mr. Guppy's merit in the construction of the *Great Britain*. Real genius disdains to appropriate, without acknowledgment, the improvements of others; thus Sir S. Bentham referred, as above, to the Chinese and to the ancients. Whether Mr. Guppy may have re-invented the expedients in question, or have perceived the advantage of them, as proved by the actual service of the vessels in which they were exemplified, and have adopted them, to him must be ascribed the benefit which ship-building cannot fail to derive from his introduction to general use, of Sir S. Bentham's improvements in naval architecture".*

Sir J. Rennie, President, after expressing to Mr. Guppy the thanks of the meeting for the communication which had given rise to so interesting a discussion, said the construction of iron sea-going vessels was a subject of peculiar interest to the institu-

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* Since the receipt of this communication, the Secretary has received from Lady Bentham a paper; from which the following extract is made:—"It is now half a century since Sir Samuel Bentham, in conversation with the First Lord and other Lords of the Admiralty, satisfied them, that the general principles of mechanics were as applicable to naval as to civil architecture, although they never, up to that time, had been scientifically applied to the construction of ships. The consequence was, that the Admiralty induced him to undertake the construction of six vessels of war and a water vessel, in every respect conformably to his own uncontrolled ideas, and under his sole direction. These vessels were the sloops, the *Arrow* and the *Dart*, and the schooners, the *Netley*, *Millbrook*, *Redbridge*, and *Eling*; all vessels of war.

"These vessels differed, in exterior form from the general build of vessels of war, having been larger and sharper; they projected or raked forward above the water-line, like a wherry; the top sides, instead of retiring inwards, were continued flaring outwards to the upper edge. By this difference in form, the vessels were better supported than the usual ones, when pitching or rolling in a sea, and it was found that they both pitched and rolled easily. In actual service they proved excellent sea boats, sometimes keeping their station on an enemy's coast, when other ships of war were forced to run for safety; sometimes making their port when all other vessels on the same station were driven down channel; sometimes out-sailing vessels in company at sea. The *Netley* was the only vessel on the station that could be sent in-shore off Havre, in the night, because she was the only one that could be depended on for working off a lee-shore in any weather, 'when they dared not trust the frigates.' To use the words of the 'Elements and Practice of Naval Architecture,' 'They have, generally speaking, been found to sail remarkably well; but in a head sea and tempestuous weather, their superiority as sea boats has been most decided.'

"For giving strength to these vessels several new expedients were introduced, such as—

"*In the construction of the vessel:*

1. Diagonal trusses, or braces of oak, to prevent racking.
2. Fixed bulkheads, longitudinal and transverse, for fixing the bottoms, sides, and decks together.
3. Thick, strong pieces under the ends of the beams, in lieu of knees.
4. Increased thickness of the outer planking, and of the deck.
5. Straight decks fore and aft.
6. Placing the timbers at right angles to the rising line of the dead wood, instead of being all the way perpendicular to the keel.
7. Passing the beams between the timbers, so as to afford means of connecting the beams immediately to them.
8. Choice of timbers; namely, that of small scantling but well seasoned, by having lain long in the sap.
9. Avoiding the use of grain cut timber.

"*In respect to fastenings:*

10. Trenails of a shape of his invention, in steps, that is, of different diameters in different parts of their length, the greatest at their head, the least at their point, with conical heads engine-turned. These trenails held faster than the usual ones, yet the timbers in which they were inserted were less wounded than by the ordinary trenails.
11. The use of augers for making holes of corresponding exactness with the trenails, so that the holes might be perfectly filled up, to the exclusion of water and moisture. These trenails, so inserted, kept the planking of the bottom in perfect contact with the timbers, notwithstanding the most severe caulking.
12. Short metal screws, hollow in the thickest part, the heads of a shape for holding firmly, and more particularly for fastening the butt-ends of the plank.
13. Bolt nails of a mixed metal, of a shape and of a hardness that admitted of their being driven into oak or fir, without splitting the wood.
14. Instead of bolts, only clenched-on rings. A new description of bolt, with screws on the ends; nuts to screw upon them, and plates, both for screwing the nuts against, and for receiving the heads of the bolts. Thus the bolts were not only drawn more firmly at first, but they admitted of being screwed up more tightly, in case of shrinkage of the wood.
15. Nails of a new form for sheathing, having flat and smooth heads, and tapered only in one direction; of pure copper, instead of mixed metal; thereby not liable to contaminate the sheathing on remelting.

"*Expedients against loss, by injury to the bottom, and against foundering.*

16. Extra thickness of plank for the lower part of the vessel, as above mentioned; it having been 6 inches intead of only 3 inches, as usually employed.
17. Terminating the plank against the dead-wood, so that the dead-wood, the lower part of the stern-post, or even the keel itself, might have been beaten off, without letting water into the vessel.

tion, as to one of its early members must be ascribed the merit of their first introduction.

The first iron steam vessel that ever went to sea was built in 1820-1 at the Horseley iron-works, near Birmingham. It was named the *Aaron Manby*, after the constructor; and being put together in the Surrey Canal Dock, took in a cargo of rape-seed and iron castings, in the Thames, a[n]d landed it at the Pont Royal, at Paris, witho[ut] transhipment. This unique voyage w[as] performed under the command of Capt[ain] Sir Charles Napier, R. N., who was large[ly] interested in the undertaking, and devote[d] much time and his usual skill and energy t[o] the enterprise. The engine was put togeth[er] and was worked during the voyage, by th[e]

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18. Giving such a form to the rudder, that although the bottom part might have been beaten off, still enough would have remained to steer the ship by.

19. In the *Arrow* and the *Dart*, hawse-holes in the stern, the same as in the bows, to enable them to be brought to anchor in a narrow channel, riding stern foremost.

20. A pre-eminent improvement against foundering, was the water-tight compartments, first introduced in these vessels. That is, the longitudinal and transverse bulkheads, so efficient, as above mentioned, in point of strength, by being made water-tight, divided the vessel into several water-tight compartments, so that, although water should have entered into two or three of these compartments, the vessel would not sink.

"*Against accidents from explosion:*

21. Instead of casks, metallic canisters for keeping powder. These canisters were air and water-tight, and were so arranged, as that in case of alarm of fire, water might easily have been let in over and around them, without injury to the powder, and so that after the danger were over, they could speedily be laid dry again.

22. Safety-lamps in lieu of a magazine light-room. These lamps were encompased by a double casing of glass, filled in between with water; the whole so contrived, that in case of breakage of the glass, the water would extinguish the light.

"*Expedients with a view to efficiency in point of stowage-room, and to the health and comfort of the crew.*

23. Instead of store-rooms, against the sides of the ship, fixed bins, not higher than tables, were introduced, leaving a clear space around them, as well as above them, so that besides easier access to the stores, the sides of the vessel were left clear to get at them, to stop shot holes.

24. The powder canisters were adapted to the shape of the vessel; consequently a much greater quantity of powder would be stowed in a given space, than where the powder was in casks.

25. The invention of metallic tanks for holding water, instead of casks; with a view to the preservation of water sweet at sea.

26. The adapting those tanks to the stowage of a much larger store of water than usual. This was effected by forming them to the shape of the vessel, so that no space was lost between them and the sides, nor between one and the other of them, as necessarily must be in the case of casks. The framing of these tanks also contributed to the general strength of the vessel, by its extending from the bottom to the deck, and so connected to them, as to form a part of the general fabric.

27. Thick pieces of glass as illuminators, either flat or convex, were introduced in various parts of the vessel, usually dark, but where light was very desirable.

28. Greater distance than customary between deck and deck, so as to give height for the men to stand upright.

"The expedients introduced in these vessels with a view to economy in their structure, were—

"*In regard to timber:*

29. The use of small timber, of which there were abundance in that market, instead of large timbe[r] of which there was an increasing scarcity, th[e] smaller timber being from 25 to 50 per cent. cheap[er] than the large.

30. The use of timber of kinds less costly tha[n] oak, but using those cheaper kinds only in parts fo[r] which they were appropriate, as elm and beech, f[or] parts always under water, fir for parts where strengt[h] was required, in resistance to tension, in the dire[c]tion of the fibre.

31. No knees.

32. No crutches nor breasthooks.

33. No carlings nor ledges.

34. Little or no footwalings, circles, or insid[e] planking.

"*In regard to metal:*

35. Short metal screws.

36. Screw-pointed bolts, whereby half the usu[al] number of bolts was saved.

37. Sheathing nails of pure copper.

38. Bolt nails of mixed metal, instead of coppe[r].

"The efficiency of these expedients for the[ir] intended purposes was proved in the long an[d] active service of these several vessels.

"In point of strength, they were exposed to [a] variety of severe trials without injury. Among[st] others, the *Millbrook*, after launching, was left dr[y] at low water near Southampton by some acciden[t] across and hanging on a log of wood; her shee[r] was not broken, nor did she sustain any othe[r] injury. The *Dart*, in the year 1799, with her gun[s] and stores on board, ready for action, on going u[p] the Texel, with much smaller vessels, and whe[re] no other of her force and size dared venture, fre[]quently got aground, and dragged and beat again[st] the shoal, without being in the least injured. Th[e] *Redbridge*, of no more than 160 tons, yet carryin[g] fourteen carronades, sixteen pounders, had one o[f] them, by accident, loaded with three shot, togethe[r] with the full charge of powder, and which wa[s] fired off without the least injury to the vessel. O[n] board the *Dart*, one of her thirty-two pounder car[]ronades, was fired no less than eighty rounds suc[]cessively, and with an expedition far exceedin[g] what is possible with ordnance mounted in th[e] usual manner, yet the vessel was not in the leas[t] affected by it. On the same occasion, the *Cli[]* fired four hundred round shot from her afterm[ost] carronade, without doing the slightest injury o[n] board. In many letters it was stated that, afte[r] storms and the roughest weather, not so much a[s] the paint or whitewash on the seams of the s[] several vessels had been disturbed. On an offic[ial] survey of the *Dart*, and this after she had been i[n] service seven years, it is stated in the official repor[t] of that survey, and amongst many other proofs o[f] strength, 'I do not find one decayed timber in he[r] a circumstance exceedingly uncommon in ships o[f] such an age. I do not perceive an evidence of eve[n] the pitch of the butts on the gangway havin[g] cracked. On the most minute survey, more th[an] once or twice, I discovered not the least sign o[f] working. The calking at the wooden ends w[as] perfectly sound and good. The oakum in th[e] seams was perfectly dry and solid; even the in[]dents remain in it, caused by the sawn edges o[f] the plank, &c.'

"It seems proper to add, that the *Dart* had bee[n] in many actions previous to that survey.

present Secretary of the Institution. The propellers were the feathering paddles, which were invented by the late Mr. John Oldham. Both the engine and the paddles had been superseded by more perfect machinery, and the boilers had been frequently renewed; but the hull of the vessel had required but little repair, and was still at work upon the Seine, as were several other iron vessels built by Mr. Manby, about the same time, at Horseley, and at his works at Charenton, near Paris.

The introduction of iron, as a material for ship-building, was now becoming so general, that the result of the great experiment, the *Great Britain*, must necessarily be regarded with much interest, and next session, the Institution would look forward to receiving from Mr. Guppy an account of the first few voyages; and, if skill and experience could accomplish them, they might be considered safe in the hands of Captain Hosken, whose success in the *Great Western* had been so decided.

"In respect to the expedients against foundering, besides the examples these vessels afforded, of their security after beating on the ground, it must be noticed that, since of late water-tight compartments have been adopted, striking instances have occurred of the preservation of life by this expedient.

"*As to stowage-room, and health and comfort of the crew.*

"The space gained by the above-mentioned and other minor arrangements may best be judged of by a comparison of that between decks in an eight-and-twenty gun frigate and the *Dart*. In a frigate of 28 guns, taken for comparison, there were but 10,278 cubic feet between decks; whilst between decks of the *Dart* there were 19,306 feet; or in the frigate, 52 feet to a man, in the *Dart* sloop, 137 feet to a man.

"The *Dart* and *Arrow* were of about 500 tons; but though carrying the number of guns of a 28-gun frigate, they had a sloop's complement of men.

"A much greater quantity of powder and of various other stores were stowed in a given space. The quantity of water was nearly double; and, what is of great importance in regard to this necessary store, by the invention of metallic tanks water can be preserved sweet at sea. A quantity of water, that had been no less than three years in one of the tanks on board the *Dart*, having been sent, in the year 1800, duly verified in every respect, to the Society of Arts, their honorary gold medal was awarded to Sir Samuel Bentham for this invention.—(*Vide* Trans. Soc. Arts, vol. xix. 1801. Pp. 191 and 374.)

"Metallic tanks have since been very generally adopted, with the difference in favour of those now used, that they are of the cheapest metal—iron; but on the contrary, they have usually the disadvantage of not being shaped to the form of the vessel, and of not contributing in any way to the strength of its structure.

"*Saving of first cost.*

"It appeared from the Report of the master shipwright of Deptford Dockyard, on comparing the quantity of timber employed for the *Dart* with that consumed for a frigate of the same size, the *Maidstone*, and taking into account, in both cases, the loss on conversion, that not a seventh part of that used for the *Maidstone* had been necessary for the construction of the *Dart*.

"The absolute saving in copper, together with that of the timber, was so great, that a contractor dealing with the Navy Board, and conversant with the structure of these vessels, made a direct offer to that Board, to build a frigate, according to this new mode of structure, for little more than half the price paid for vessels of the same magnitude, according to the usual mode.

"In addition to the improvements exemplified in the above-mentioned vessels, may be specified, Sir Samuel Bentham's invention of 'Coqueing.'

"This mode of connection, he described, as applicable to framed work in general, in all cases, where the force to be resisted tends principally to make the pieces slide one over the other. It was particularly noticed and approved of, by the Lords of the Admiralty, on their visitation of the Dock Yards in the year 1802.

"The most important advantage of this invention, is the very great additional strength given to vessels, of which the parts are so combined. Besides this, savings are effected by it in various ways; by the saving of timber, for instance, where coqueing is employed, instead of tabling, as in making masts, in which case the saving of workmen's wages alone, amounted to 25 per cent.; that having been the reduction made, on the price paid them for putting masts together, when this mode was introduced.

"This invention was soon very generally adopted by private ship builders, and has been used in some cases of civil architecture and engineering, to which arts it is equally applicable. The Ordnance Department also very soon adopted it."

ELECTRIC LIGHT IN MINES.

Sir,—Allow me to correct an error into which your correspondent, Dr. Cormac, has fallen in regard to the employment of electric light in coal-mines. Although he considers it unnecessary to go into the details of the subject, he could not do anything which would have been more to the purpose; for the electrician well knows that the light cannot be applied to any practical purpose till some method is discovered of rendering it continuous or constant. When a light is produced from charcoal points, they are volatilized with rapidity, and destroyed. To illustrate this, I will mention one of the numerous experiments I have made in endeavouring to overcome this difficulty. When a powerful Grove's battery of forty pairs was employed, pencils of that hard and very incombustible coke found in the inside of gas retorts were consumed at the rate of from half an inch to an inch per minute, and that too in a glass globe filled with nitrogen gas, and thus entirely excluded from the oxygen of the air. Wood charcoal is volatilized much more rapidly. The attempts made at Paris and elsewhere have been entirely defeated by this obstacle; and indeed there does not seem any way of overcoming it,

it is the direct result of the production of the light, or rather flashes of light, as that is all that can be done. I wish the obstacle could be overcome, as lighting by electricity would supersede all other modes, and be of incalculable value to the world.

Respectfully yours,
ELECTRICS.

NEW PROCESS FOR SILVERING GLASS.

Sir,—Having made several attempts to silver glass by the process described in your Magazine, vol. xlii. p. 408, being the process described by Professor Faraday; and as many persons might be desirous of performing these experiments, which are exceedingly interesting and beautiful, and require very nice manipulation, I will describe a mode which I adopted with complete success, and seldom failed in the attempt. Add to wood naphtha an equal quantity of distilled water, until the naphtha becomes cloudy; into this mixture put a few drops of the silver solution mentioned below (I am supposing the vessel to be an ounce phial), and heat the mixture in a hot-water bath. In a few days the solution will become brown; filter, and then put in a few more drops of the silver solution. Finally, put in a few drops of oil of cassia and oil of cloves: a very small quantity only is required.

In a short time the bottle containing the mixture will become of a beautiful dark purple colour, and ultimately become perfectly white. A few drops more of the two oils will make more silver precipitate. The silver solution is prepared as follows:—Dissolve nitrate of silver in distilled water; pour in a small quantity of spirits of hartshorn (not the strong caustic ammonia), until a small precipitate takes place; immerse the bottle containing the mixture in warm water, and the precipitate will redissolve, and become clear.

I am, Sir,
Your obedient servant,
M.

P.S. It is but recently this discovery has been brought under the notice of the French Academy of Sciences; and our neighbours, as usual, carefully concealed all mention of the name of our ingenious countryman, who first made the discovery about a year or two back. It may be observed, that the celebrated Count Rumford long ago precipitated both gold and silver by means of those oils; but he did not follow up the discovery to the perfection it is now arrived at. As it has always been thought that gold would give a better reflecting surface to glass than either silver or quicksilver, it would be very desirable to make the experiment with that metal. Count Rumford describes the reflecting surface from gold as being most brilliant; but he could only procure a small surface.

MECHANICAL GEOMETRY—MR. JOPLING'S SEPTENARY SYSTEM.

Sir,—Every plane section of a cone or cylinder is also the intersection of solids.

1. The intersections of a cylinder with a cylinder will produce the circle and the ellipse.

2. The intersections of a cylinder with a cone will also produce the circle and the ellipse.

3. The intersection of a cone with a cone will produce the circle, the ellipse, the hyperbola, and the parabola.

But let there be the least deviation in size, or from the position which gives any of these plane intersections, then the intersections enter into another character of line, no more than three points of which can be on the same plane.

Many other curves may be thus produced, both such as return into themselves and such as have infinite branches; all which gradually vary from the conic sections.

All the plane intersections of a cone or cylinder may be projected on any other plane making any angle with the plane of projection. And all other winding intersections of the cone and the cylinder may be projected on any plane. Each different position of the plane of projection will give a different form to the line projected.

In one position, as an example, the projection may be the arc of a circle; in another, an egg-shape; in another, a figure in the form of the figure of eight; and as the position is varied, every possible variety between these distinct characters is given.

All these appear to be embraced by the Septenary System.

I am, Sir,
Your obedient servant,
JOSEPH JOPLING.

29, Wimpole-street, September 10, 1845.

VELOCIPEDES.

Sir,—I find, in page 144 of your Number for the present month, a notice of a new railway velocipede, there stated to be an improvement upon those in previous use. I take the liberty of suggesting to you that, if agreeable with your convenience, a notice of this invention, detailing its principle and mode of action, would much interest several of your readers. In this district (Suffolk) the people are much interested in the subject of locomotives for common roads, and many velocipedes are used. But a good one is still a desideratum. I have tried Hankins's Pedemechan, and most of the others in vogue, and wish very much, in common with other members of the Mechanics' Institute here, of which I am honorary secretary, to see a machine superior to any of these.

I trust you will pardon the intrusion of this subject; and can only add, that if you can comply to any extent with my request, you will much oblige,

Your obedient servant,

HENRY THOMPSON, JUN.

Framlingham, September 1, 1845.

[We shall be obliged if the inventor of the machine referred to by our correspondent will forward a description.—ED. M. M.]

RECENT AMERICAN PATENTS.

[Selected and abridged from Mr. Keller's Reports in the *Franklin Journal.*]

A MACHINE FOR MAKING BRICKS FROM UNTEMPERED CLAY. *Benjamin H. Brown.*—The clay, as it is taken from the bank, is deposited in a hopper by elevators, and from the hopper it passes between two rollers, that move with different velocities, by which it is drawn through in thin cakes, and thrown on to a set of permanent teeth, and there cut up by the action of sets of teeth on a roller that work between the permanent teeth. It is then conducted by a spout into a moveable mould, which, when filled, slides under a piston, actuated by a cam, to be compressed and formed into a brick, which is then discharged by a follower, actuated by another cam that forms the bed of the mould.

Claim.—" I do not claim the use of the cams for operating the pistons in pressing brick, nor do I claim the manner in which the bricks are received, compressed, and delivered; but what I do claim as my invention, and which I desire to secure by letters patent, is the arrangement of the two cams for effecting the pressure and delivery of the bricks, in combination with the pistons and moveable mould. I also claim the combination of the rollers and pins for pulverizing the clay as above described."

A MODE OF MARKING AND LETTERING PACKAGES. *William Francis and William Johnson.*—The patentees say, " The nature of our invention consists in running a composition of glue or molasses (with other materials if deemed necessary to elasticity and preservation) into moulds of letters, figures, and devices, &c., formed on lines, upon which (while in a warm state) is applied thin slats of wood, or other substance, of the width of the lines, with beveled edges, which, adhering to, is drawn with the composition from the moulds; when said composition becomes properly cooled, the moulds being previously oiled, these slats, when cut or separated between the letters, form type. The type when made are placed in the order required on a hand press formed of bars of wood or other material, with wire or other springs placed at regular distances, fastened on said bars, on the top or surface of which said springs are attached small blocks of wood, or other material, forming a smooth level surface, on which are placed the type, and fastened by means of slides, or otherwise, the springs admitting the type and blocks on which the type are placed, to play in a groove formed in the bars of the press, for the purpose of giving way when the face of the type touches an uneven surface, or until the whole surface of the type, and that of the package or article marked, come in complete contact with each other."

AN IMPROVED APPARATUS FOR SEPARATING LIQUIDS BY CENTRIFUGAL FORCE FROM SUGAR AND OTHER SUBSTANCES. *Joseph Hurd.*

Claims.—" My invention, and that which I claim as an improvement, consists in the employment, in the manner set forth, of a cylinder, or other proper shaped vessel, capable of receiving and holding a mass of sugar or other material, and whose sides are composed of a porous material of such strength and character as will retain the mass of sugar, or other substance to be operated on, and at the same time permit the passage of the liquid matters (proceeding from the mass) through them, when the said vessel is put in such rapid revolution as to generate in the liquid, or liquids, a sufficient degree of centrifugal force to expel it, or them, from the mass as described. And in combination with a vessel so arranged and operated, I claim the cistern, wholly or partially surrounding the same, or so connected with the same as to catch and retain, or suffer to escape into a proper receptacle, the liquid matters as they are expelled from the mass in the vessel; and I further claim the combination with the vessel, of a means

of supplying water or other cleansing liquid to the central or other suitable part of the mass of sugar, or other material to be cleansed, for the purpose of dressing or cleansing, &c. as set forth. Also, the manner of dressing or cleansing sugar, or other matters susceptible of being so dressed or cleansed, viz.: by passing a current of water, or other suitable cleansing liquid, into the interior of the mass, and from thence driving it through and out of the mass by centrifugal force, substantially as explained."

AN IMPROVEMENT IN FRICTION MATCHES. *Elisha Smith.*—The patentee says—"I do not claim the combining with phosphorus, or other inflammable substance, an unearthly combustible material mixed with it, or made by means of a glutinous substance (such as glue or gum arabic) to adhere to and surround and protect it from oxidation, or the absorption of moisture; neither do I claim the employment of glue, or a gelatinous liquid or substance, for the purpose of cementing the phosphorus and protecting material together; because I believe that such earthy and gelatinous materials, whether together or separate from each other, have long been employed both in this and foreign countries for such purpose. But that which I do claim consists in the employment, in the manufacture of friction matches, of *combustible* materials, such as pulverized dried bark, wood, or other *vegetable* matters substantially the same in character, instead of mineral and other substances, for the purpose of protecting the phosphorus or inflammable substance, and for giving consistency or body to the paste, as above set forth. And, particularly, I claim the using of vegetable matters (such as hemlock bark, oak bark, sumach, nut-galls, &c.) containing more or less tannin, and which, when combined with the glue or gelatinous adhesive mixture, form "*tanno gelatin,*" or an insoluble substance, which, although almost, if not entirely proof against the absorption of moisture, will readily be consumed by fire—the whole being substantially as hereinbefore explained."

LIST OF PATENTS GRANTED FOR SCOTLAND, FROM THE 12TH TO THE 22ND OF AUGUST, 1845.

Hugh Cogan, merchant and manufacturer, of West George-street, Glasgow, for an improved method or methods for weaving in patterns or various colours or fabrics. August 20

William Newton, 66, Chancery-lane, Middlesex, civil engineer, for improvements in machinery to be employed in the manufacturing of nails, rivets, screws, and pins. (Being a communication from abroad.) August 20.

James Ivers, of Preston, Lancaster, machine maker, for certain improvements in machinery or apparatus for preparing, roving, and slubbing cotton, wool, and other fibrous substances. August 21.

William Breynton, of the Inner Temple, London, esq., for certain improvements in rotary steam-engines. Aug. 21.

William Eccles and Henry Brierly, both of the township of Walton-le-dale, Blackburn, Lancaster, for improvements in the machinery or apparatus used in spinning. August 21.

NOTES AND NOTICES.

The Smoke Nuisance at Manchester.—Several persons were lately fined 40*s.* each at the Manchester Borough-court, for not consuming the smoke of their steam engine furnace. It appears from report of the proceedings in the *Manchester Guardian*, that the question of the practicability of greatly diminishing, if not altogether extinguishing this evil, was set at rest by the evidence of Mr. Henry Houldsworth and Mr. Thomas Ogden, the chimneys of whose works have long set an example to the district. Mr. Houldsworth stated, and, as far as such matters can be proved in a court of justice, proved, that the means essential to an almost perfect combustion of smoke were by no means costly; that, in ordinary cases, they might be applied at a cost of 10*l.* or 15*l.*; and that the result, while it secured all that could be desired in the removal of the nuisance, was in his case attended with a saving in his consumption of fuel of not less than 18 per cent. In the three years 1838-1840, his consumption of coal was one ton per hour; in 1841 the smoke-consuming apparatus was adapted to his furnace, and in the three following years, 1842-1844, his consumption of coal was reduced to 16 8-10ths cwt. per hour. The general accuracy of these statements, impugned by Mr. Armstrong, was confirmed by Mr. Fairbairn, C.E., who stated that two simple elements only were needed to ensure the consumption of smoke—a sufficiently high temperature, and the admission to the furnace of a sufficient quantity of atmospheric air. Some attempt was made to contravene the statements of Mr. Houldsworth, on the ground that his experiments, made some time ago, were fallacious; but it was observed, that three years of practice and experience take from the trial the character of an experiment, and leaves it in the position of a well-established fact.

Fall of the Ballee Khall Suspension Bridge.—In Number 1106 we gave a description of this bridge, erected for the Indian Government, on Mr. Dredge's plan. It will be seen, from the following account of its fall, that no blame is attached to the principle. "A sad accident recently occurred a few miles from Calcutta, but fortunately without injury to life or limb. The Bally Khall Suspension Bridge, the largest ever constructed in India, just as it was completed, gave way in the middle, and fell into the creek over which it was erected. The accident is attributed to an error in judgment of the contractor, while making some necessary alterations, and does not in any degree affect the principle on which the bridge was built."—*Indian paper.*

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1154.] SATURDAY, SEPTEMBER 20, 1843. [Price 3*d.*

Edited by J. C. Robertson, No. 166, Fleet-street.

THE ATMOSPHERIC RAILWAY SYSTEM.—MR. MALLET'S METHOD OF OBTAINING THE VACUUM.

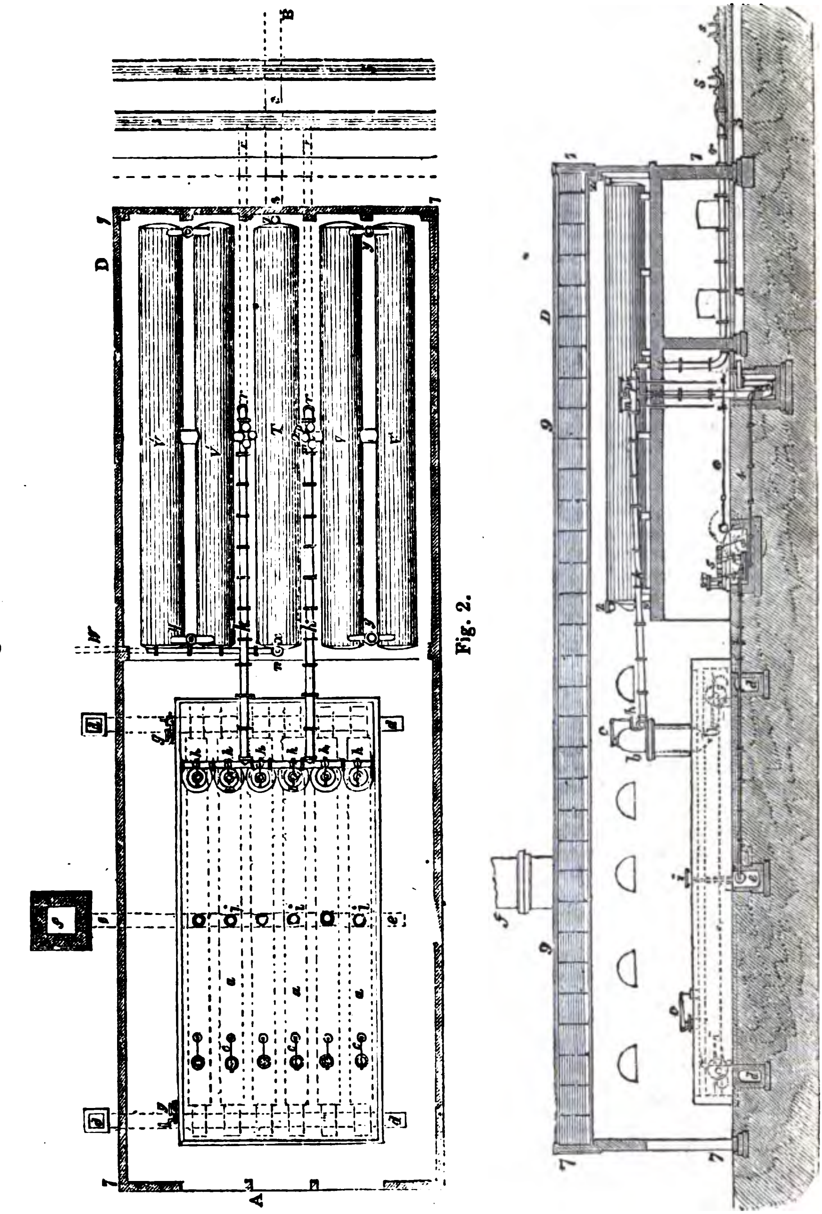


Fig. 1.

Fig. 2.

MR. MALLET'S METHOD OF OBTAINING VACUUM FOR ATMOSPHERIC RAILWAYS BY DIRECT CONDENSATION OF STEAM.

THE last No. of Mr. Weale's Quarterly Papers on Engineering contains three valuable Reports, by our frequent and esteemed correspondent, Mr. Robert Mallet, "Upon Improved Methods of Constructing and Working Atmospheric Railways." The following is given as the origin of these papers:—

"In the latter part of the year 1842, I was called upon by Mr. James Pim, jun., of Dublin, to devote my thoughts to the possibility of improving the means of obtaining the vacuum for use upon atmospheric railways. The experimental Dalkey line had just then, I believe, been determined on; and Mr. Pim stated that it was an object of the highest importance to those interested in the Atmospheric Railway Patent, to devise means for obtaining the vacuum, more efficient and economical than had, up to that time, been proposed; namely, than exhaustion by the air-pump of the main direct. The following three Reports were the results of the consideration which I accordingly gave to the subject, and which were communicated in November and December, 1842, to Mr. James Pim, jun., and, at his request, to Mr. Bergin, Dr. Robinson, Ast. Royal, Armagh, and to the late Mr. Jacob Samuda. I also consulted my excellent and learned friend, Dr. Apjohn, T.C.D., upon the conclusions I had arrived at. The proposals of improvement contained in these Reports, or my discoveries and inventions, (if I may so characterize them,) were ably investigated in a rigid form by Dr. Robinson, whose calculations were submitted to me subsequently, and less fully, by Dr. Apjohn; and by these parties, together with Mr. Pim and Mr. Bergin, were they admitted as having been fully established, and their results to be of the utmost possible importance, as regarded the future economic working of atmospheric railways. Mr. Jacob Samuda, alone, was, or affected to be, of a totally different opinion. The only semblance of an argument against my views, however, which I was at any time able to obtain from him, either orally or written, was a memorandum or calculation as to the properties of my vacuum reservoirs, of which a verbatim copy is given in the Appendix.* The style of this document, and the methods of calculation which it reveals, will probably enable those who are versed in pneumatic investigations to decide how far this gentleman was competent to the examination of such questions.

"The first Report contains the development of my plan for using the *air-pump, worked by a comparatively small power, for the constant exhaustion of air-tight reservoirs or vacuum vessels, to be brought into communication with the atmospheric main when it became necessary to share their vacuum therewith.* The results given as to power and effect are calculated upon the experimental data, horse power unit, &c., given by Professor Barlow, in his able Report to the President of the Board of Trade, presented to Parliament in 1842. The main conclusions, and all the important parts of Professor Barlow's Report, remain to the present hour unshaken; but Mr. Bergin, being at the above period engaged in the publication of his 'Observations' upon this Report, in which he assumed some different data, as to leakage, unit of horse power, &c., I was requested by Mr. Pim to recalculate my results, adopting Mr. Bergin's data. These are embodied in the second Report, together with a description of some details of arrangement, proposed by me for the practical working of an atmospheric line upon my method of exhaustion, and ridding it of a practical difficulty or objection suggested by Dr. Robinson. The third Report ennunciates my invention of *the method of obtaining vacuum for atmospheric railways by the direct condensation of steam in close vessels or reservoirs, capable of being brought into communication with the main,* and investigates its conditions as to power

---

No. 9.

* *Copy verbatim of the late Jacob Samuda's memorandum, dated 9th Dec.* 1842.

16) 52·24 (3·26 lbs. mean per □ in. from 0 to 16 in. [vacuum.
42
104
8
8) 42·65

5·33 lbs. mean per □ in. from 0 to 16 in. to in. [vacuum.

A pump containing 30 *c F* will extract a mean of 22 *c F* of solid air per stroke, while exhausting reservoir from atmospheric density to 16 in. mercury; if, therefore, the reservoir contains 100 *c F*, it will acquire a rarefaction 16 in. mercury in 2·42 mins.

3·0) 16

22) 533 (2·42
93
53
3·0) 80·0

26·6

The same pump will extract a mean of 10 *c F* of solid air, per stroke, when exhausting a reservoir from 16 in. to 24 in. mercury, therefore it will effect this increase in the same reservoir, in 2·66 mins.

The power exerted in the former case will be 3·26 lbs. × 2·42 mins. =
and in the latter case, 5·33 lbs. × 2·66 mins. =
but as the reservoir would be but half the capacity in the first case, the reservoir being necessarily twice the contents of the main, the former result must be divided by 2.

and effect; it also contains comparative estimates of the outlay for exhausting apparatus, as do also the two former Reports." —*Introduction*, 3—4.

Fig. 3.

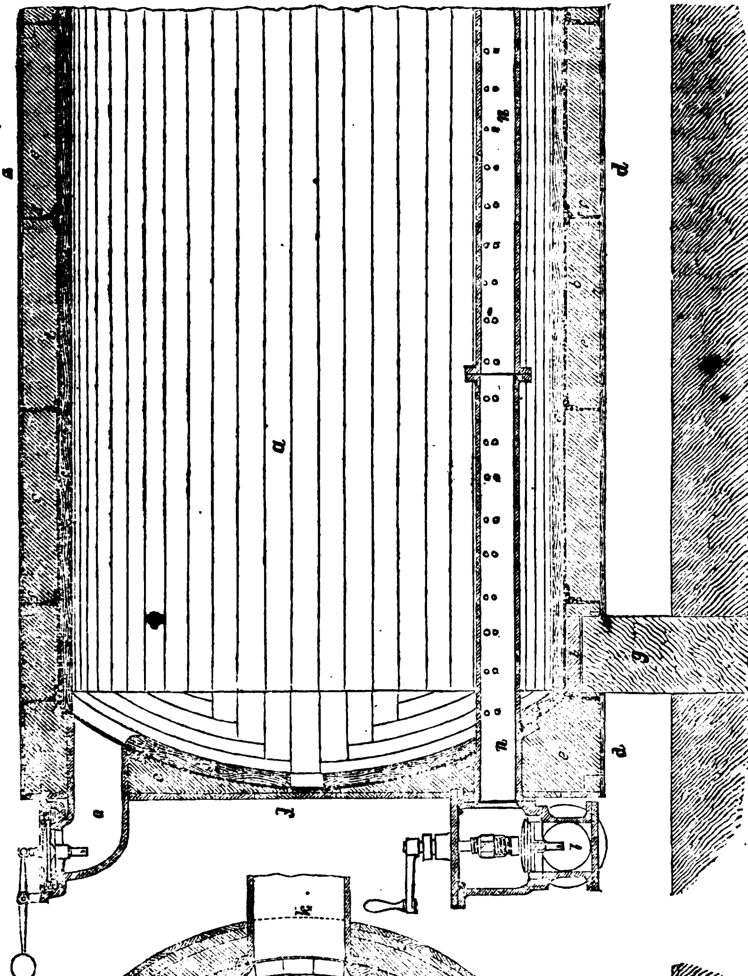
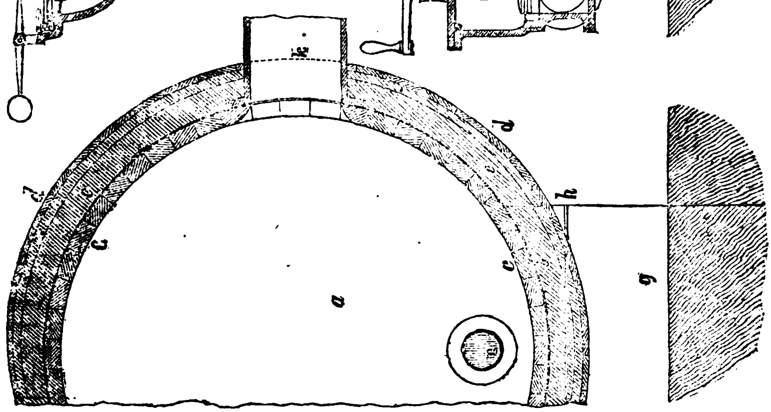


Fig. 4.



But this is not the whole of the history of these papers; for it appears from an

Appendix that they have given rise to two questions of considerable interest, connected with the copyright of inventions.

The *first* relates to Mr. Mallet's plan of storing the vacuum. Messrs. Clegg and Samuda, in the specification of their first patent, have these words, "If the trains are required to be started as frequently as possible, the engines are employed constantly exhausting the pipe; but if a longer period than is necessary to exhaust the pipe be required to elapse between starting the trains, the engines are employed IN THE INTERVAL to exhaust large vessels or reservoirs, which, when the train starts, are opened to the pipe to *assist* to obtain the vacuum therein, and to maintain it till the train has passed." Messrs. Clegg and Samuda say that this passage contains a complete anticipation of Mr. Mallet's plan, as disclosed in his Report, No. 1; and Mr. Pim takes the same view of the matter. Mr. Mallet, on the other hand, contends that "the sentence in the specification that proposes to use the engines to exhaust reservoirs, *in the intervals between trains*, under certain circumstances, was no publication of his invention for their *constant and continuous use at all times, both during the intervals of trains and during their transit, or in circumstances where there were no intervals*—in a word, FOR ABANDONING ALL EXHAUSTION OF THE MAIN DIRECTLY BY THE AIR-PUMP." We think Mr. Mallet entirely in the right, and are only surprised that a gentleman of Mr. Pim's keen penetration and strong judgment should not have instantly recognized the great difference there is between the two cases. (That Messrs. Clegg and Samuda should, *as patentees*, choose to confound them is natural enough.) The only idea common to the parties is that of storing up a vacuum, (which, as it happens, is new to neither;) but if the first suggestion of such a thing were to be held to comprehend and forestal all that can ever arise out of it, there would be an end to all proprietary value, in the application of scientific knowledge to useful purposes. Robert Mallet is no inventor in the sense only that James Watt is none; for both have only shown how to turn to a vast profitable account, a source of power of which all the world was previously well aware.

The *second* question of right relates to the method of obtaining the vacuum by direct condensation of steam, described in Mr. Mallet's Memoir, No. 3. The date of this Memoir, is 15th November, 1842; and that Memoir was communicated, in confidence, to Mr. Pim and certain other parties, who are not accused of having violated that confidence. For the sake of greater security, Mr. Mallet deposited with the Royal Irish Academy, on the 13th November, 1843, a sealed packet, which, on being opened in presence of the Academy, on the 20th May, 1845, was found to contain three MSS., descriptive of Mr. Mallet's improvements in obtaining vacuum power on atmospheric railways; and these three MSS., we are led to infer, are precisely the same in substance as the three Memoirs now published. (We say "led to infer," because Mr. Mallet does not state as much in plain and distinct terms.) But, between the first date, 15th November, 1842, and the last, 20th May, 1845, Mr. James Nasmyth took out a patent for an improvement in atmospheric railways, which happens to be substantially the same with that which Mr. Mallet had taken so much pains to keep secret.*

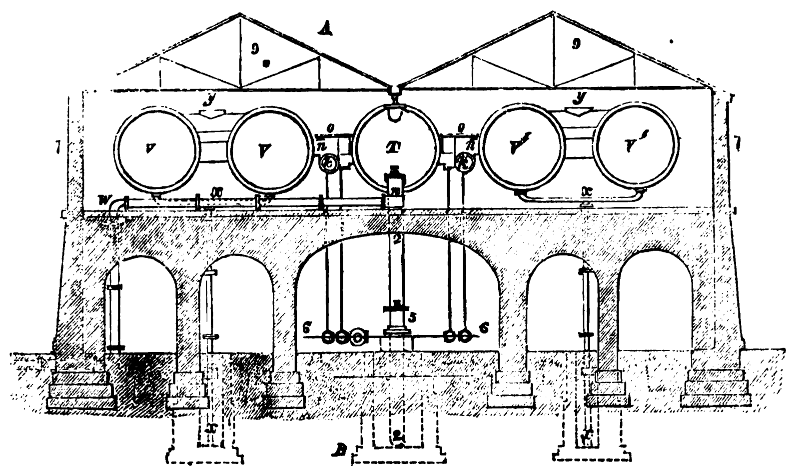
"The method of exhaustion by direct condensation of steam has been *re-invented* within a year or so, by Mr. Nasmyth, of Paticroft, near Manchester, who has patented an arrangement for the purpose, (sealed Oct. 22, 1844,) which differs in no essential particular from mine as described in my Report, No. 3, and *published* prior to the date of his patent."—Appendix, p. 66.

Now, on this second question, our judgment must be as decidedly against Mr. Mallet, as in the previous instance it was in his favour. We think he must, on farther reflection, see the absolute necessity of retracting the assertion that his plan was "published prior to the date of his (Mr. Nasmyth's) patent." There was no publication. On the contrary, Mr. Mallet did his utmost to prevent publication—to keep his plan as secret as pledges and sealed packets could make it. For anything that the public knew of Mr. Mallet's plan on the 22nd October, 1844, when Mr. Nasmyth's patent was sealed, it was all the same as if it had never existed. Nobody had, before the date of Mr. Nasmyth's patent, "pub-

* For full details of this method see *Mech. Mag.* vol. xlii. p. 430.

lished" what Mr. Nasmyth then disclosed to the public; and being the first to make it public, he is, in the eye of the law, the only "first and true inventor." Nor in the eye of the law alone; for this is a case in which law and common sense happen to be in excellent accordance. For, granted that Mr. Mallet invented the same thing before the date of Mr. Nasmyth's patent, but kept it secret, how can we be sure that he is the only person who is in that situation? Is it quite impossible that there should have been other prior inventors and other sealed packets? And are we in a case where verification is so difficult and simulation so easy, to open the door to all and sundry to come in and try their luck at this game of dormant pretensions? What title of discovery would be safe, if subjected to such an ordeal? Again, if those who impugn Mr. Nasmyth's title are not to be held bound by the principle of publicity, why should Mr. Nasmyth? Certainly, the date of Mr. Nasmyth's patent was not the *actual* date of his invention any more than the date attached to Mr. Mallet's Memoir, No. 3, was that on which the plan described in it first occurred to his mind. From what date, then, (supposing the fact of publication to be disregarded)

Fig. 5.



ought we to begin to reckon Mr. Nasmyth's title? And from what Mr. Mallet's? To such questions as these it would clearly be vain to hope for any satisfactory answer. To depart from the principle of publicity is to get at once involved in inextricable obscurity and confusion. To adhere to it is not only a necessity arising out of the circumstances of the case, but a necessity enforced by the strongest considerations of public policy. The keeping of an invention secret which is calculated to add to the wealth or resources of a country, is as actual a public loss as if so much treasure of gold and silver were thrown into the sea; and to diminish as much as possible the number of such losses is, or ought to be, an object of earnest solicitude with all Governments. Patents and privileges, therefore, for all who add anything to the common stock of inventions; and wherever there happens to be two competitors, to him the preference, who is foremost in the race.

The Memoir, No. 3, which forms the subject of this conflict of claims between Mr. Mallet and Mr. Nasmyth, is that to which we think it likely the public will be disposed, at the present moment, to attach the most interest. We propose, therefore, (with the obliging permission of Mr. Weale,) to transfer it entire to our pages. Whether Mr. Nasmyth or Mr. Mallet is to be regarded as the true author of the method of exhaustion by direct condensation of steam, this at least

must be allowed, that no one has more ably demonstrated its practicability and advantages than the author of the present paper.

On the means of Producing Vacuum for the Atmospheric Railway by the Direct Action of Steam. With an example of six miles of railway main exhausted in one length. By Robert Mallet, Esq., A. B., Mem. Inst. C.E., M.R.I.A., &c. &c.

(15th Nov. 1842.)

In the case of vacuum procured for locomotive purposes by means of an air-pump wrought by a steam-engine, it is plain that the engine can only be considered as a primary machine to produce a vacuum, the power resulting from which is again transferred to a second machine, the air-pump, whose function it is to reproduce the vacuum whose resulting power is to be applied to effect locomotion.

Hence, of the power of the coal, or theoretical power of the steam, there must be lost, that due to work these two complex machines themselves. The residue can alone be that available for locomotion.

It therefore would appear, that if the generation and condensation of steam in close vessels of suitable capacity could be conveniently effected, its whole theoretic power, with some very small deductions, would be directly available in producing vacuum for locomotion. But besides this very general view, important practical considerations, especially relating to the conditions of working the atmospheric railway system, seem to be involved in the latter mode of obtaining the vacuum.

It is admittedly of great value to be able to use the longest possible lengths of tube between station and station, and to be able to procure a vacuum in the largest length of tube with the greatest rapidity.

On the existing method, any increased length of tube, or rapidity of exhaustion, can only be obtained by a proportional augmentation in the capacity of the air-pump, and an equally proportionate increase of steam power; but as no means are as yet provided for using this power to advantage between the times of trains, and as steam must be always up in the engine boilers, any increase in the rapidity of exhaustion must be attended with a proportionate loss of fuel, beyond that only necessary to meet the increased demand for power.

Now in further considering this new mode of producing vacuum by the direct application of steam, it will appear:—

1st. That greater lengths of tube may be more rapidly exhausted than would probably be ever proposed to be attempted with the air-pump alone.

2nd. That such lengths of tube may be exhausted to a sufficient degree with great rapidity, and the tube discharged as the train advances.

3rd. That an economy of power, or in fuel, will result.

4th. That the apparatus may be so arranged that the whole of the steam generated between the trains shall be made available to produce vacuum.

5th. That the required apparatus will be more simple, and subject to less wear and tear, than an engine and air-pump of equal power, and certainly not more costly in original outlay.

6th. That this method admits of combination with my other proposal for "storing the vacuum," so as to economize the whole power wasted between trains upon the present system.

We will first, then, briefly describe the apparatus proposed being used, as designed for six miles of fifteen-inch tube. This consists generally of a system of boilers to generate steam, arranged upon a modification of the Cornish construction, and with peculiar adaptations for withdrawing the fires when steam is not demanded; of two sets of vessels wherein the vacuum is produced, and which I call "vacuum vessels," each consisting of two cylinders; and lastly, of a third vessel, called the condenser, in which the steam which has been generated in the boilers, and been blown into the vacuum vessels, expelling the air therefrom, is condensed, leaving them vacuous.

The boilers are six in number; five are required to be in action at once, leaving one for cleaning; each of these is cylindrical, on the Cornish plan, but with a fire-place at each end; the flues meeting in the centre of the length, and with a large super-imposed steam-chest to contain a sufficient volume of steam to fill the vacuum vessels alternately with rapidity. Steam is to be produced in these boilers at 45 lbs. per square inch, above the atmosphere, and will blow off into the vacuum vessels, down to low pressure, or almost to atmospheric pressure.

The construction of the boilers is such as to admit of the withdrawal of the fires from beneath all those in use, by a simultaneous movement, into a brick-arched vault or cavity, the supply of air and the chimney dampers being shut off by the same movement. The air within the cavity and boiler flues is thus almost immediately exhausted by the fires, of its oxygen, and replaced by carbonic oxide and acid gases and various inflammable products of the coal. The fuel thus ceases to burn, but remains hot, and smouldering, until again steam is wanted; when the fires are passed in under the boilers, air is re-admitted, the inflammable gases in the flues in part take fire, and are consumed, or pass off, and the vigorous combustion of the fuel is recommenced.

The radiated heat of the fire, which had previously been absorbed by the brick-work of the arch of the cavity, is now carried off by the stream of cold air into the boiler flues, and becomes available, and thus no part of the fuel is lost at any period of the operation. This improvement is obviously applicable to boilers of any sort when intermittingly employed, for any other purpose, as well as on the present system of the atmospheric railway.

The proportions of these boilers are taken from those of the best Cornish examples, and are calculated to boil off, from a temperature of 70° Fahrenheit, rather more than four cubic feet of water per minute into steam, at 45 lbs. per square inch above the atmosphere, five of the boilers being at work; and to perform this, with a consumption of not more than 5·9 lbs. avoirdupois of good coal for each cubic foot of water so evaporated.

The boilers are jacketed as in Cornwall; the feed-water passes into a large pipe placed in the last flue (next the stack), and acquires there a temperature of nearly 212° Fahrenheit before it enters the boilers.

A main steam-pipe, connected with all these boilers by stop-valves, unites with two branches by which steam is brought to the vacuum vessels and condenser.

The vacuum vessels are two in number, and are to act alternately; each consists of two cylinders of boiler plate, stiffened by ribs on the outside, jacketed with sawdust and sifted ashes outside, and lined with staves of pine 3 inches thick throughout the interior, as shown at large on the plans; the construction of the shell of the condenser is precisely similar, and its capacity is equal to that of one of the vacuum vessel cylinders. That is, the capacity of the condenser is one-half that of the vacuum vessel.

The two cylinders forming each vacuum vessel are in free communication, and the only reason of using two cylinders in place of one, is, that a much larger diameter would be in danger of compression, unless stiffened at great cost; and a much greater length would be inconvenient. The capacity of the vacuum vessels is determined by that of the tube to be exhausted.

Between each of the vacuum vessels and the condenser are placed three double beat valves, (or six valves in all;) the functions of one of them with reference to each vacuum vessel is to admit steam thereto alternately, and shut it off; of another, to establish or close alternately communication between the vacuum vessels and condenser; and of the third, to establish and close alternately communication between the vacuum vessels and railway tube.

The object of lining both the vacuum vessels and condenser with wood (a bad conductor of heat) is, that the former being alternately filled with steam and with air at common temperature, and the latter having nearly a constant rush of steam into it to be condensed, it is desirable that the inner surfaces of these vessels should be in a condition neither to receive nor to give out heat; or in other words, to change temperature as little as possible, all such change being in the case of the vacuum vessels attended with waste of steam, and of the condenser with waste of condensing water.

Condensing water is supplied to the condenser by a perforated pipe and stop valve, from a reservoir or source with a head of four or five feet of water.

The condensing water and condensed steam are removed from the condenser, and the condensed steam that may form in the vacuum vessels, by means of inverted syphon pipes, with a balance valve at the lower end, and having a total difference of level between this point and the lowest part of the vacuum vessels or condenser of 34 feet.

(*To be continued in our next.*)

TABLE IV.

(Continued from page 87.)

For finding the root of the Equation $x^3 - P\,x = r$, when $\frac{r^2}{p^3}$ is greater than $\frac{4}{27}$. The tabular equation being $y^3 + y^2 = \frac{r^2}{p^3}$.

y	$y^3+y^2=$	Limiting divisors.		y	$y^3+y^2=$	Limiting divisors.	
		$z=\cdot01$	$z=\cdot0$			$z=\cdot01$	$z=\cdot0$
·34	·154904	10471	10268	·85	1·336625	39031	38675
·35	·165375	10881	10675	·86	1·375656	39747	39388
·36	·176256	11897	11088	·87	1·415403	40469	40107
·37	·187553	11719	11507	·88	1·455872	41197	40832
·38	·199272	12147	11932	·89	1·497069	41931	41563
·39	·211419	12581	12363	·90	1·539000	42671	42300
·40	·224000	13021	12800	·91	1·581671	43417	43043
·41	·237021	13467	13243	·92	1·625088	44169	43792
·42	·250488	13919	13692	·93	1·669257	44927	44547
·43	·264407	14377	14147	·94	1·714184	45691	45308
·44	·278784	14841	14608	·95	1·759875	46461	46076
·45	·293625	15311	15075	·96	1·806336	47237	46848
·46	·308936	15787	15548	·97	1·853573	48019	47627
·47	·324723	16269	16027	·98	1·901592	48807	48412
·48	·340992	16757	16512	·99	1·950399	49601	49203
·49	·357749	17251	17003	1·00	2·000000		50000
·50	·375000	17751	17500				
·51	·392751	18257	18003	1·1	2·541	627	583
·52	·411008	18769	18512	1·2	3·168	719	672
·53	·429777	19287	19027	1·3	3·887	817	767
·54	·449064	19811	19548	1·4	4·704	921	868
·55	·468875	20341	20075	1·5	5·625	1031	975
·56	·489216	20877	20608	1·6	6·656	1147	1088
·57	·510093	21419	21147	1·7	7·803	1269	1207
·58	·531512	21967	21692	1·8	9·072	1397	1332
·59	·553479	22521	22243	1·9	10·469	1531	1463
·60	·576000	23081	22800	2·0	12·000	1671	1600
·61	·599081	23647	23363	2·1	13·671	1817	1743
·62	·622728	24219	23932	2·2	15·488	1969	1892
·63	·646947	24797	24507	2·3	17·457	2127	2047
·64	·671744	25381	25088	2·4	19·584	2291	2208
·65	·697125	25971	25675	2·5	21·875	2461	2375
·66	·723096	26567	26268	2·6	24·336	2637	2548
·67	·749663	27169	26867	2·7	26·973	2819	2727
·68	·776832	27777	27472	2·8	29·792	3007	2912
·69	·804609	28391	28083	2·9	32·799	3201	3103
·70	·833000	29011	28700	3·0	36·000	3401	3300
·71	·862011	29637	29323	3·1	39·401	3607	3503
·72	·891648	30269	29952	3·2	43·008	3819	3712
·73	·921917	30907	30587	3·3	46·827	4037	3927
·74	·952824	31561	34228	3·4	50·864	4261	4148
·75	·984375	32201	31875	3·5	55·125	4491	4375
·76	1·016576	32857	32528	3·6	59·616	4727	4608
·77	1·049433	33519	33187	3·7	64·343	4969	4847
·78	1·082952	34187	33852	3·8	69·312	5217	5092
·79	1·117139	34861	34523	3·9	74·529	5471	5343
·80	1·152000	35541	35200	4·0	80·000	5731	5600
·81	1·187541	36227	35883	4·1	85·731	5997	5863
·82	1·223768	36919	36572	4·2	91·728	6269	6132
·83	1·260687	37677	37267	4·3	97·997	6547	6407
·84	1·298304	38321	37968	4·4	104·544	6831	6688

TABLE IV.—(*Continued.*)

y	$y^3+y^2=$	Limiting divisors.		y	$y^3+y^2=$	Limiting divisors.	
		$z=\cdot01$	$z=\cdot0$			$z=\cdot01$	$z=\cdot0$
4·5	111·375	7121	6975	8·4	663·264	23111	22848
4·6	118·496	7417	7268	8·5	686·375	23641	23375
4·7	125·913	7719	7567	8·6	710·016	24177	23908
4·8	133·632	8027	7872	8·7	734·193	24719	24447
4·9	141·659	8341	8183	8·8	758·912	25267	24992
5·0	150·000	8661	8500	8·9	784·179	25821	25543
5·1	158·661	8987	8823	9·0	810·000	26381	26106
5·2	167·648	9313	9152	9·1	836·381	26947	26663
5·3	176·967	9657	9487	9·2	863·328	27519	27232
5·4	186·624	10001	9828	9·3	890·847	28097	27807
5·5	196·625	10351	10175	9·4	918·944	28681	28388
5·6	206·976	10707	10528	9·5	947·625	29271	28975
5·7	227·683	11069	10887	9·6	976·896	29867	29568
5·8	228·752	11437	11252	9·7	1006·763	30469	30167
5·9	240·189	11811	11623	9·8	1037·232	31077	30772
6 0	252·000	12191	12000	9·9	1068·309	31691	31383
6·1	264·191	12577	12383	10·0	1100·000		32000
6·2	276·768	12969	12772				
6·3	289·737	13367	13167	11	1452	420	385
6·4	303·104	13771	13568	12	1872	494	456
6·5	316·875	14181	13975	13	2366	574	533
6·6	331·056	14597	14388	14	2940	660	616
6·7	345·653	15019	14807	15	3600	752	705
6·8	360·672	15447	15232	16	4352	850	800
6·9	376·119	15881	15663	17	5202	954	901
7·0	392·000	16321	16100	18	6156	1064	1008
7·1	408·321	16767	16549	19	7220	1180	1121
7·2	425·088	17219	16992	20	8400	1302	1240
7·3	442·307	17677	17447	21	9702	1430	1365
7·4	459·984	18141	17908	22	11132	1564	1496
7·5	478·125	18661	18375	23	12696	1704	1633
7·6	496·736	19087	18848	24	14400	1850	1776
7·7	515·823	19569	19327	25	16250	2002	1925
7·8	535·392	20057	19812	26	18252	2160	2080
7·9	555·449	20551	20303	27	20412	2324	2241
8·0	576·000	21051	20800	28	22736	2494	2408
8·1	597·051	21557	21303	29	25230	2670	2581
8·2	618·608	22069	21812	30	27900		2760
8·3	640·677	22587	22327				

Tables 1 and 2 will solve any numerical cubic equation that belongs to the irreducible case of Cardan's rule; and the 3rd and 4th will solve those that belong to the reducible case, provided y does not exceed 30, or y^3+y^2, not greater than 30^3+30^2, or 27900, and y^3-y^2 not greater than 30^3-30^2, or 26100. When this is the case, I will give—with your permission, Mr. Editor—a very simple formula, which will, in all such cases, give a very near approximation to the root of the equation.

GEORGE SCOTT,
Private Teacher of the Mathematics.

16, Wyndham-street, Montague-square,
August 10, 1845.

SOLUTIONS OF A MECHANICAL PROBLEM.

IN every case where a problem is proposed for solution, which has an especial bearing upon practical utility, it is essential in the solution to adapt the processes to the simplest mode of computation or construction of which they are susceptible. On this account, it may be worth while to revive the discussion

of the problem given at page 163 of the *Mechanics' Magazine* for September 6.

This problem, however, is well known amongst geometers under a slightly modified and rather more convenient enunciation. In one or other of its forms it has been discussed by Newton, Simpson, Emerson, Swale, and many other English mathematicians, both by algebra and geometry; and on the Continent amongst those who have bestowed attention upon it may be mentioned Euler, Fuss, Hachette, Cauchy, Gergonne, Steiner, Poncelet, Chasles, and Puissant. It, however, dates back to the time of Apollonius, and is elegantly restored by Vieta, in his solution of the general problem *de Tactionibus*.

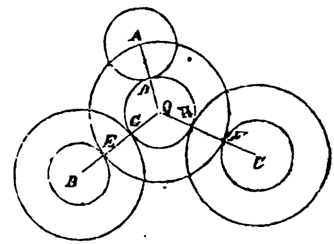
The usual method of proceeding, in treating this problem by geometry, has been to reduce the general problem to its preceding "cases of ease," or special cases; in *character* somewhat similar to Euclid's treatment of his iii. 35. Simpson is probably the only English author who has treated the general problem by an independent process, in his Select Exercises, p. 169. Most of the continental writers have employed the *centres of similitude* in the manner of Vieta, or this combined with the properties of the *radical axis*. Hachette employs the intersections of hyperbolas, (*Corr. Polyt.* i. p. 25,) and Cauchy (in the same work, p. 194) gives an independent construction for the case, where one of the circles is reduced to a point, of which the geometrical one here annexed is little more than a version of French geometry into English. It is, for constructive purposes, less laborious than any other yet given.

The algebraic solution of Gergonne (*Annales des Math.* tom. vii. p. 289) is undoubtedly the most elegant and complete, in a mathematical point of view, that has ever been given: but for the purposes of practical computation it is altogether unsuitable. The following is believed to be in all its essential particulars original, and is certainly as brief and simple in respect of computation as we can ever hope to obtain, in a case where the data comprises so many independent quantities. The nearest approach to it is by Mr. Davies, in his "Solutions of Hutton's Course," p. 492; and which it would appear, by his Scholium, was suggested to him by Puissant's solution, in his "Propositions de Géométrie," p. 176. The treatment of the equations here given is, however, essentially different from both these authors.

Problem. *To describe a circle to touch three given circles.*

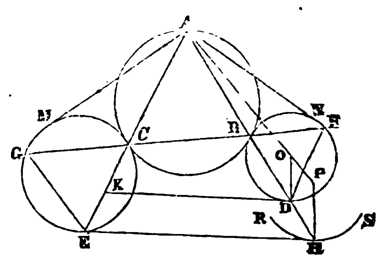
I. GEOMETRICALLY.

Let ABC be the centres, and AD, BG, CH the radii of the given circles, of which AD is less than either of the other two; and let us suppose O to be the centre of the circle which touches the other three. Then, if EG, FH be



made equal to AD, and circles be described about B and C, with BE, CF as radii, the circle AEF will touch these last-named circles in E and F, and be concentric with the circle DGH. This is too evident to need formal proof; and it enables us to reduce the problem to that of constructing the circle AEF, in order to the determination of GDH. In this form, then, it will be here considered.

Analysis. Suppose the circle ABC, constructed to touch the two given circles BDF, EGC, and pass through the given point A. Draw ACE, ABH through the points of contact C and B;



draw BC to meet the circles at G and F, and join GE, DF; draw the tangents AM, AN, from A to the given circles, and the tangents EH, DK, at E and D, to meet AB, AE, in H and K; through the centre O of the circle BDF draw AO; from H draw HP perpendicular to EH, and about P, in which HP meets

AO, describe the circle RHS; and, finally, join OD.

1. Then, by a familiar property of circles in contact, [it is readily proved by drawing tangents at B and C, and employing Euc. iii. 32] the triangles ABC, DBF, EGC are similar, and have the sides, containing the equal angles, either parallel or continuous. Whence (iii. 32) A D K = B F D = A C B, and, therefore, A K D = A B C; and, likewise, A E H = E G C = A B C: from which it follows that A K D = A E H, and that the tangents D K, E H are parallel.

2. Since O D is drawn from the centre O to the point of contact D, it is perpendicular to D K; and since H P is perpendicular to E H, and E H is parallel to D K, the line H P is parallel to OD, and the triangles A D O, A H P are similar, and O A : O P : : O D : H P.

Since the triangles ABC, AEH have ABC = AEH, and A common, they are similar, and we have A B, A H = A C, A E = A M^2; and we have also A B, A D = AN^2. Whence it follows that,

A N^2 : A M^2 : : A B. A D : A B. A H : : A D : A H : : A O : A P : : O D : P H.

But A O, O D, A N, A M, are given; and hence also, A P, P H, are given in magnitude, and the point P is given in position; whence the centre P, and radius P H, of the circle R H S are given; and E H, being perpendicular to H P, is a tangent to R H S; wherefore the point E will be determined by the contact of a common tangent to E G C and R H S. From this analysis arises the following

Construction.—Join A O, and produce *ad libitum*, and draw the tangents A M, A N, to the given circles. Make then,

A N^2 : A M^2 : : A O : A P,

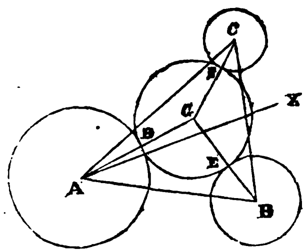
And A N^2 : A M^2 : : O D : P H.

With centre P, and radius P H, describe the circle R H S, and draw the common tangent E H to the circles E C G and R H S. Join E A, H A, cutting the circles in C and B; the circle through A B C will touch the two given ones.

The demonstration is evident from the analysis.

II. By Analysis.

Let A B C be the three centres, and r_1, r_2, r_3, the radii of the given circles; let G be the centre of the circle which touches the three, and r be its radius;



and let a b c be the sides of the triangle A B C. Draw A X to bisect the angle A, and join G A, G B, G C, which (Euc. iii. 12) will pass through the points of contact D, E, F respectively. Denote the angles X A B, X A C (or $\frac{1}{2}$ A), by a, and the angle X A G by θ. Then, by the elementary properties of the figure, we have

$$A\,G = r + r_1,\quad B\,G = r + r_2,$$

$$\text{And } C\,G = r + r_3;$$

$$\text{And } (r+r_2)^2 = (r+r_1)^2 - 2c(r+r_1)\cos(a+\theta) + c^2,$$

$$(r+r_3)^2 = (r+r_1)^2 - 2b(r+r_1)\cos(a-\theta) + b^2.$$

These last, upon expansion and transposition, become

$$2r\{c\cos(a+\theta) - (r_1 - r_2)\} = r_1^2 - r_2^2 - 2cr_1\cos(a+\theta) + c^2 \;\ldots\ldots\; (1.)$$

$$2r\{b\cos(a-\theta) - (r_1 - r_3)\} = r_1^2 - r_3^2 - 2br_1\cos(a-\theta) + b^2 \;\ldots\; (2.)$$

Cross multiply by the coefficients of $2r$, equate and simplify; then

$$(r_1 - r_2)(r_2 - r_3)(r_3 - r_1) = b\{(r_1 - r_2)^2 - c^2\}\cos(a-\theta) - c\{(r_1 - r_3)^2 - b^2\}\cos(a+\theta) \;.\; (3)$$

Write this, for the moment, in the form $R = b'\cos.(a-\theta) - c'\cos.(a+\theta) \;..\; (4)$, and find the subsidiary angle ω from the equation

$$\tan.\,\omega = \frac{(b'-c')\cos a}{(b'+c')\sin a} \;\ldots\; (5)$$

Then, by the ordinary method of treatment of such equations, we find

$$\cos.(\omega+\theta) = \frac{R}{\sqrt{b'^2 - 2b'c'\cos A + c'^2}} \;\ldots\ldots\; (6)$$

from which $\omega+\theta$ is given by the tables; and ω being given by (5), we at once find θ.

This value of θ being inserted in either (1) or (2), the value of r becomes at once known.

Scholium. We may remark that b' and c' are easily computable by logarithms, since they are reducible to

$$b'=b(r_1-r_2+c)\,(r_1-r_2-c),$$
$$c'=c\,(r_1-r_3+b)\,(r_1-r_3-b);$$

and, moreover, the denominator of (6) may be computed as the base of a triangle whose sides are b', c', and whose included angle is A; and finally, the left side of (3) is already in a form adapted to the use of logs. The computation is, therefore, in a simpler and briefer form than in any solution hitherto given.

It may be further added, that if we take $\delta_1=r_1-r_1$, $\delta_2=r_1-r_2$, and $\delta_3=r_1-r_3$, there will be some degree of abbreviation in the reductions introduced; but these changes can be easily made by the reader himself, and need not here be dwelt upon. In this case the solution would, in fact, be that of the geometrical "case of ease" which we have already given.

CENTURION.

Home, September 12, 1845.

SCREW PROPELLING IN AMERICA—THE ERICSSON PROPELLER v. THE STEVENS SCULL.

Having seen it mentioned some time ago in the public journals, that Capt. Ericsson's propeller had been removed from the United States Frigate, *Princeton*, and another substituted for it invented by a Mr. Stevens, which had shown itself on trial decidedly superior, we have read with more than ordinary interest the following official reports on the subject just brought to England (appropriately enough) by the *Great Britain*, which we are happy to observe behaved as entirely to the satisfaction of all concerned on her first return voyage, as during her first passage outwards. (The only thing complained of is a deficiency of steam.) We insert also some very pertinent remarks on these Reports which appear in the Boston Journal from the pen of a correspondent, with the pseudonyme of "Nauticus." What the construction of "the scull" is which has taken the place of Capt. Ericsson's propeller we are not informed; but we presume, from the name, that it is something in the screw way, with more of a sculling action than belongs to other propellers of this class. We learn from other documents which we have received by the *Great Britain*, that Captain Ericsson has a claim for no less than 15,080 dollars for professional services rendered in the planning and superintending the construction of the steam machinery of the *Princeton*, which the American Executive objects, on apparently very frivolous and discreditable grounds, to discharge. Whether the disputes which have arisen about Capt. Ericsson's claim have had anything to do with the removal of Captain Ericsson's propeller does not appear; but seeing how little that removal has been justified by the results (for on this point we hold most of the reasonings of "Nauticus" to be incontrovertable,) it is impossible not to entertain considerable suspicions.

The Official Reports.

A Trial of Speed against Time, made with the U. S. ship "Princeton," on the 4th March, 1845, in the harboar of Norfolk, with the "Ericsson Propeller," the distance run being one mile, carefully measured, proceeding from a point marked A to a point marked B, and each quarter was marked by stakes with flags hoisted on them.

FIRST SERIES.

Time of starting from A	Time of arrival at B	Time from A to B.	Course.	lbs. steam.	Throttle valve holes opn.	Vacuum.	
						Star. eng.	Lar. eng.
1 27 30	1 33 30	6	N. W. ½ W.	17	4	25	27
2 10	2 15 59	5 50	N. W. ½ W.	18	4	25	27
2 41	2 46 42	5 42	N. W. ½ W.	18	4	25	27

Second Series.

Time of starting from B.	Time of arrival at A.	Time from B to A.	Course.	lbs. steam.	Throttle valve holes opn.	Vacuum.	
						Star. eng.	Lar. eng.
2 4	2 9 7	5 7	S. E. ½ E.	18	4	25	27
2 31	2 36 6	5 6	S. E. ½ E.	18	4	25	27
2 47	2 52 7	5 7	S. E. ½ E.	18	4	25	27

The above time was taken by a stop watch, on deck.

The following time, steam, and revolutions of the wheel were noted in the engine room :—

Time.	lbs. steam.	Number revolutions.	
6	17	174	[29]
5	18	150	[30]
5 50	18	175	[30]
5 3	18	150	[29·7]
5 40	18	175½	[31]
5 4	18	153½	[30·5]
32 37		978	

The depth of water was from quarter less four to seven fathoms.

Ship's draft of water was as follows :—

Aft .... 18 feet 8 inches.
Forward .... 15 feet 7 inches.
Difference .... 3 feet 1 inch.

The tide was low—slack water. The water was smooth, and a light breeze from the eastward. Top gallant and royal yards in the rigging. A comparison between the two trials will show a gain of the Stevens scull over the Ericsson propeller of 32 seconds in a mile, or more than one mile in eleven.

Signed, R. F. Stockton, Capt.

[978 revolutions in 32 m. 37 sec., gives about 30 per minute, or 5·6 less than the Stevens scull.]

A Trial of Speed against Time, made with the U. S. "Princeton," on the 22nd March, 1845, in the harbour of Norfolk, with the "Stevens Scull," the distance run being one mile, carefully measured, proceeding from a point marked A to a point marked B, and each quarter was marked by stakes with flags hoisted on them.

First Series.

Time of starting from A.	Time of arrival at B.	Time from A to B.	Course.	lbs. steam.	Throttle valve holes opn.	Vacuum.	
						Star. eng.	Lar. eng.
12 55	1 4	5 4	N. W. ½ W.	18	4	26	27
1 28	1 33 16	5 16	N. W. ½ W.	18	4	26	27
*	*	*	*	*	*	*	*

Second Series.

Time of starting from B.	Time of arrival at A.	Time from B to A.	Course.	lbs. steam.	Throttle valve holes opn.	Vacuum.	
						Star. eng.	Lar. eng.
12 36	12 41	5	S. E. ½ E.	18	4	26	27
12 50	12 54 50	4 50	S. E. ½ E.	18	4	26	27
1 10	1 14 48	4 48	S. E. ½ E.	18	4	26	27
1 35	1 39 40	4 40	S. E. ½ E.	18	4	26	27

The above time was taken by a stop-watch, on deck.

* In consequence of vessels in the way, the series could not be completed from A to B, and was finished by running from B to A.

The following time, steam, and revolutions of the wheel were noted in the engine-room:—

Time.	Lbs. steam.	Number revolutions.	
5	18	180	[36]
4 50	18	174	[36]
5 5	18	182	[35·8]
4 50	18	172	[35·6]
5 18	18	185	[35]
4 44	18	167	[35·3]
29 47		1060	

The depth of water was from quarter less four to seven fathoms.

Ship's draft of water was as follows:—

Aft.............. 13 feet 8 inches.
Forward........... 15 feet 7 inches.
Difference .... 3 feet 1 inch.

The tide was low—slack water. The water was not so smooth as before, and a top-gallant breeze from the westward. Top-gallant and royal yards in the rigging.

A comparison between the two trials will show a gain of the Stevens scull over the Ericsson propeller of 32 seconds in a mile, or more than one mile in eleven.

Signed, R. F. Stockton, Capt.

[1060 revolutions give about 35·6 per minute.

Note. 4 miles made with top-gallant breeze, and 2 miles against the same.

Time going 1st mile, agst. wind 5·04
Time going 3rd mile, with wind 4·48

Difference................ ·16
Time going 2nd mile, agst. wind 5·16
Time going 4th mile, with wind 4·40

Difference................ ·36]

Remarks. By "Nauticus."

The gain claimed is one mile in eleven, and to the eye of the public, or that part of it which would not afford time to scrutinize this report, the face of it would show that the "Stevens scull" really is superior to the "Ericsson propeller." But let us give this report an impartial examination.

The ship appears to have been in the same trim as to draft of water, and the distances run we take for granted were the same; the pressure on the boiler was the same throughout, with the exception of the first mile during the trial of the Ericsson propeller, and then one lb. less steam was carried, and the vacuum in the starboard engine, with the propeller, was one pound less throughout, which is equal at least to one pound less pressure on the boiler. Th same number of throttle-valve holes wer open, and the same vacuum in the engine appears to have existed throughout the tria in both cases, with the above exception The wind in the first case was "light from the eastward," the tide, in both cases, "low slack water." The average number of re volutions of the propeller was 30 per mi nute, and of the scull 35·6.

The wind, on the trial of the "scull," according to the report, blew "a top-gallan breeze from the westward." Now I be you will understand that I do not profess t know much about steam. I am no en gineer; yet on a careful examination of thi report, I am obliged to confess that I canno see wherein consists the superiority claimed for the "scull" over the "Ericsson pro peller."

How do I come to this conclusion? I will tell you. I cannot but believe, in th first place, that the 5·6 additional revolu tions of the "scull" per minute helped ma terially the apparent gain of 1 mile in 11.

I also cannot fail to notice that "in con sequence of the number of vessels in th way," the ship could not complete the serie of miles to be run with and against the wind but that she completed the series by run ning, altogether, *four miles with the "top gallant breeze,"* and two miles *against* th same.

Let us examine the comparative time oc cupied by running with and against the wind

The two miles run against it, or to th N.W. ½ W., the wind being to the west ward, occupied 5 m. 4 sec. and 5 m. 16 sec respectively, at 1 h. 4 m. and 1 h. 33 m 16 sec. The last two miles run with th wind were done in 4 m. 48 sec., and 4 m 40 sec., making a difference in the aggregat of 26 sec. in the mile, and in the last tw miles run, with and against the wind, of 3 sec. in the mile in favour of the fair wind with the same pressure on the boiler, an about the same number of revolutions of th scull per minute.

The report comes direct from the com mander of the *Princeton* to the Navy De partment, and cannot be questioned. Taking then, the report itself, I cannot see wher the superiority of the "Stevens scull" i made manifest over the "Erricson pro peller." It is fair to infer too, that th *Princeton's* copper was cleaner after comin from dock, than it was when she went in t it to make the change of the "propeller" for the "scull."

The public has never been informed wh the "Ericsson propeller" was condemne or taken out of the *Princeton* to give plac to the "Stevens scull."

The report to the Secretary of the Navy, Mr. Henshaw, dated 5th February, 1844, by Captain Stockton, goes to show, that the *Princeton* was considered a perfect ship, in all respects, for he says :—

"Constructed on the most approved principles of naval architecture, she is believed to be at least equal to any ship of her class, *with her sails*. She has, also, an auxiliary steam power, and can make greater speed than any sea-going steamer, or other vessel heretofore built."

"The advantages of the *Princeton* over both sailing vessels and steamers propelled in the usual way, are great and obvious. She can go in and out of port at pleasure, without regard to the force and direction of the wind and tide, or the thickness of the ice. She can ride with safety with her anchors in the most open roadstead, and may lie-to in the most severe gale with perfect safety. She can not only save herself, but will be able to tow a squadron from the dangers of a lee shore, using ordinarily the power of the wind, and reserving her fuel for emergencies."

I might quote much more from the report of Captain Stockton, to show that the *Princeton* was considered perfect at the time the report was made. If the change was made for the purpose of testing two rival inventions, it is pretty clear to me that the object has been attained, so far as to show, at least, that the "Stevens scull" is not superior to the "Ericsson propeller." I am informed that the 5·6 revolutions of the scull required an additional force of full 70 horses over and above that required to turn the propeller. If this be true, I cannot make out the gain claimed.

What has the scull done then? To which I am answered: That with the same pressure of steam on the boiler, but with a greatly increased consumption of said steam, it has propelled the ship faster, the means being increased rather more than in proportion to the effect produced.

The rate at which the *Princeton* was reported to have steamed in the Delaware, with "Ericsson's propeller," by ground log, was 13½ statute miles, with 36·6 revolutions.

The table of captain Stockton shows that with 30 revolutions she made 11·04 miles; and with the scull, making 35·6 revolutions, she made within a fraction of twelve miles per hour, or six miles in 29 m. 47 sec.

Now a comparison of the rates at which the two powers moved, and the rate attained in the Delaware, and at Norfolk, would show as follows :—

As 30 : 36·6 = 11·04 : 13·4 proving incontestably that the rate obtained in the Delaware by the "Ericsson propeller" may be depended on.

It also proves that had the "propeller" moved as fast as the "screw," it would have propelled the ship faster than the latter.

Besides the difference stated, namely, the four miles made with the wind, and two against it; the difference of pressure throughout, in one engine of a force equal to 1 lb. pressure on the boiler, and the possibility of the ship's bottom having been in better order after being in dock, I am informed that one of the plates of the propeller had been so much bent by striking a log or stake in New York harbour, that it became necessary to cut it partially away, and that one or more of the other five plates were more or less bent out of angle. I am also informed that this damage was not rectified before the final trial of the propeller.

Finally, I would call the attention of those who feel any interest in the matter, to the fact, (derived from Captain Stockton's own report,) that the engines were worked with the scull as fast as they were ever worked before; yet the former maximum speed was not attained within nearly 1½ miles per hour. Thus, to attain the former maximum speed, if not impossible, will require a speed of the engines for which they were not constructed, and which they cannot safely bear for any continued period.

NAUTICUS.

RECENT AMERICAN PATENTS.

[Selected and abridged from Mr. Keller's Reports in the *Franklin Journal.*]

AN IMPROVEMENT IN THE COUPLING AND STUFFING-BOX FOR SHAFTS, SPECIALLY INTENDED FOR SUBMERGED PROPELLERS FOR SHIPS. *R. F. Loper.*—The outer tube of the stuffing-box, instead of being permanent, is tapped into a metallic casing surrounding it so as to admit of screwing it over the lapped or other joint of the shaft, so that when this tube is drawn in, the two shafts can be separated, and, if desired, the propeller drawn up out of the water, and when screwed out, passes over and prevents the two shafts from being separated.

Claim.—"Having thus fully described my improvements, what I claim therein, and what I desire to secure by letters patent, is the before-described mode of employing the cylindrical tube for the double purpose of a coupling-box and stuffing-box, by combining it with the coupling shaft and with the other portions of the stuffing-box; by which arrangement much room is saved, and great simplicity attained—all as herein described."

A METHOD OF DIRECTING THE COURSE OF AEROSTATS OR BALLOONS. *Muzio*

Muzzio.—To run fourteen years from the 12th of May, 1842, the date of Letters Patent granted in France.

Claim.—"Having thus fully described the manner in which I construct and operate my balloon, or aërostat, I will remark, that I am aware that inclined planes have been applied to aërial machines for the purpose of enabling them to ascend by the resistance of the air; it having been attempted to propel such machines by flapping instruments called wings, by revolving screws, by paddles, and by other similar means. I am also aware that machines thus attempted to be propelled have been furnished with jointed inclined planes, for the purpose of guiding them in the manner of the tail of a bird; it is to be understood, therefore, that I do not claim as of my invention the mere application of inclined planes for the decomposition or resolution of the ascending and descending forces. But what I do claim as my invention, and desire to secure by letters patent, is the combination of inclined planes, substantially as herein described, with an aërial machine, or balloon, which is made to ascend and descend by a change in its specific gravity, as set forth; the ascending and descending forces decomposed or neutralized, and resolved into a horizontal one, or rather into a progressive line more or less inclined to the horizon, by the aid of atmospheric resistance; whereby the whole machine is impelled forward, and the direction changed at pleasure, by altering the inclination of the planes; the same being effected substantially as herein described. But it is to be distinctly understood that I do not limit my claim to the number or to the form of the inclined planes, or to the particular manner of operating them, or to the manner of obtaining an ascending and descending force, so long as the same is effected by a change of a specific gravity of the balloon, which, it will be evident, may be effected by the generation of hydrogen, as well as by its discharge."

Improvements in the Method of Regulating the Draught of Stoves and Furnaces. *Joseph Saxton and George Elliot.*—In this stove all the joints are made with the view to have them all air-tight, as near as practicable, by luting or other known means. The fuel is introduced through a hole in the top covered by a disk, having a flanch around it, and dipping into sand contained in an annular trough, or cup. The ash-box, which is circular, is also provided with an annular cup containing sand, which, when borne up, receives a rim, or ring, surrounding the opening of the grate, and for the purpose of bearing up the ash-box it rests on three circular inclined planes, which force it up when turned partially round; when let down it can be drawn out in the usual manner.

The air for feeding the fire is admitted through a small hole governed by a valve connected with a compensation bar attached to the stove. This compensation bar is composed of two metals of different expansibility, the most sensitive being placed next the stove, and the connexion between the bar and the valve is by means of a regulating screw; when the temperature is too great the bar expands, and permits the valve to close and cut off the supply of air, and when it contracts the valve is opened to admit air.

A Machine for Mincing Blubber on board of Ships engaged in the Whale Fishery. *George Kilburn and John J. Kilburn.*—This machine consists of a wheel, one face of which is at right angles with the shaft, and the other bevelled towards the periphery. To the straight face of this wheel, a curved knife is attached, which extends from a little beyond the periphery to about midway between the periphery and the centre, and back of this knife the wheel is pierced with a bevelled opening. The blubber is fed up to the cutter in a hopper, the bottom of which is a little below the range of the outer extremity of the knife, so that each slice that is cut, is not entirely severed from the mass.

THE ATMOSPHERIC RAILWAY.—R. W.'S PLAN.

Sir,—Perhaps your correspondent, R.W., will be so kind as to give a minute description of the form and mode of action of the revolving double valves to which he alludes in your last Number. I can readily understand how a piston may open a valve at the end of, say a three-mile length of tubing, but cannot comprehend how a piston can possibly open and close the valves placed as R. W. proposes. If he can satisfy us in this respect, we shall have cause to tender him our best thanks, as undoubtedly in that case it must be a very ingenious contrivance.

I am, Sir, your obedient servant,

Frederick Lipscombe.

93, Regent-street.

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

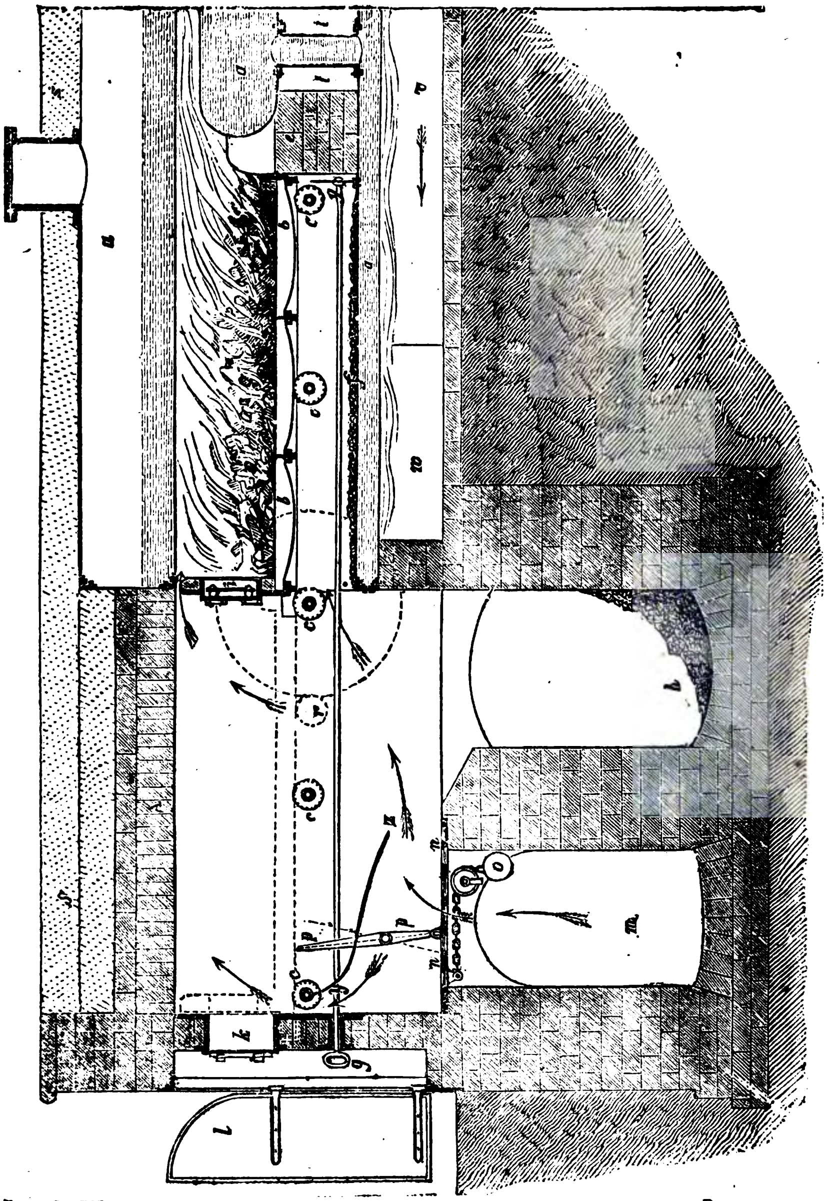
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1155.] SATURDAY, SEPTEMBER 27, 1845. [Price 3*d.*

Edited by J. C. Robertson, No. 166, Fleet-street.

THE ATMOSPHERIC RAILWAY SYSTEM.—MR. MALLET'S METHOD OF OBTAINING VACUUM.

Fig. 6.



MR. MALLET'S METHOD OF OBTAINING VACUUM FOR ATMOSPHERIC RAILWAYS BY DIRECT CONDENSATION OF STEAM—(CONTINUED FROM P. 199.)

THE only remaining valves are the "snifting valves," or large balanced valves at the ends of the vacuum vessels to give egress to the air on admitting steam, and similar but smaller ones to the condenser.

These latter valves are self-acting. The six former valves spoken of, viz., the three belonging to each vacuum vessel, are moved either by hand, or by a motion derived from suitably formed "cams," actuated by the same very small steam-engine which is required to feed the boilers with water.

It is proposed to condense the steam, so that the condensing water shall flow off at 70° Fahrenheit; at this temperature such quantity of it as is required is withdrawn by the feed pumps from the well at the lower end of the condenser syphon, and pumped into the hot-water tube in the boiler flue before spoken of.

This constitutes the whole apparatus, its operation is as follows:—

Steam being up in the boilers, a little is blown off into the condenser, and the stop-valve shut; the condensing water is admitted, and a very slight vacuum is produced in the condenser. This is requisite to cause the steam from the first vacuum vessel to enter the condenser rapidly, when permitted. The steam valve is now opened to one vacuum vessel, say the left-hand one, the other two valves, viz., the condenser and railway valves, being shut. The air is expelled from it by the snifting valves, and as soon as steam "blows through," the valve from the boiler is shut, and the condenser valve opened; the contents of the vacuum vessel now rush into the condenser, and are condensed. The valve between the vacuum vessel and condenser is now shut, and that between the former and railway tube opened, when air from the latter rushes into the partial vacuum of the vessel.

The moment the steam valve was shut to the left-hand vessel, it was opened to the right-hand one, which in the same way was filled, and by a precisely similar set of operations a partial vacuum was formed in it, and communication made between it and the railway tube just subsequent to the moment when communication was closed between it and the former vessel, and so on alternately, each vessel being filled with steam; this condensed, a vacuum produced, and air admitted therein from the railway tube until in equilibrium.

These actions recur at regular intervals, and the cams moving with a uniform motion, are so arranged as to open and close the several valves at the proper times.

These times and the general working of the machine, which is much more simple than it seems in words, are best seen by inspecting the following diagram or expression in signs of the whole motions. (For which see opposite page.)

It will thus be observed that each of the vacuum vessels is alternately engaged in exhausting the railway tube and in forming its own vacuum. The valves are at the first moment moved by hand, and afterwards uniformly by the engine, which is worked by the same steam boilers as are employed in the apparatus at large.

We have next to consider the proportions of the various parts of the apparatus. Let us suppose, as applicable to a length of six miles of 15-inch pipe.

The capacity of the tube is

$$\overset{\text{ft.}}{5280} \times 6 \times \overset{\text{sq. ft.}}{1{\cdot}227} = 38872 \text{ cubic feet.}$$

The capacity of each condensing vessel we will assume to be one half this $= 19436$ cubic feet. And as each consists of two cylinders—

$$\frac{19436}{2} = 9718 \text{ cubic feet, capacity of one.}$$

These cylinders may be made of 10 feet diameter $= 78{\cdot}54$ square feet area.

$$\text{Hence the length} = \frac{9718}{78{\cdot}54} = 124 \text{ feet.}$$

The capacity of the condenser need not be more than one half that of either condensing vessel, for such a proportion has been found to give sufficiently rapid condensation in large steam-engines, and the same must hold here. Hence the condenser will be one cylinder of 10 feet diameter, and 124 feet long.

The dimensions of the boilers are dependent upon the supply of steam demanded per minute.

We shall presently see that a sufficient vacuum for starting will be produced in a 15-inch pipe of six miles long, by three

Working of the Vacuum Apparatus.

Section of Apparatus.		Left hand Vacuum vessel Plenum.		Condenser partial Vacuum.			Right hand Vacuum vessel vacuum.		
Pieced Moved.		Railway valve.	Steam valve.	Left vacuum valve.	Condensing water valve.	Right vacuum valve.	Steam valve.	Railway valve.	
Time.	Change.								Change.
0 min.		Shut.	Open.	Shut.	Shut.	Shut.	Shut.	Open.	
30″.			Shut.	Open.	Open.				*Exhausting*
				Shut.			Op en.	Shut.	
		Open.							
1 min.	*Exhausting*								
						Open.	Shut.		
		Shut.	Open.			Shut.		Open.	
30″.									
			Shut.	Open.					*Exhausting*
2 min.		Open.		Shut.			Open.	Shut.	
	Exhausting					Open.	Shut.		
30″.		Shut.	Open.			Shut.		Open.	
3 min.									*Exhausting*
			Shut.	Open.					
		Open.		Shut.					
30″.					Constantly open while at work.		Open.	Shut.	
	Exhausting					Open.	Shut.		
4 min.		Shut.	Open.			Shut.		Open.	
30″.									*Exhausting*
			Shut.	Open.					
		Open.		Shut.			Open.	Shut.	
5 min.	*Exhausting*								
						Open.	Shut.		
		Shut.	Open.			Shut.		Open.	
30″.									
			Shut.	Open.					*Exhausting*
6 min.		Open.		Shut.			Open.	Shut.	
	Exhausting					Open.	Shut.		
30″.		Shut.	Open.			Shut.		Open.	*
7 min.									

Note.—To make this Table completely intelligible, the reader should rule lines across at intervals of ten seconds.

exhaustions of one vacuum vessel, and that three to four more exhaustions will discharge the tube as the train advances. Now if the speed of the train be 30 miles per hour, 6 miles will be passed over in 12 minutes, which gives an interval of 3 minutes between each exhaustion. This is the limit therefore for the supply of steam. We must have as much steam as will blow the air out of, and fill one vacuum vessel every three minutes at 212° Fah., or the power of this in the boilers. But for the more rapid and effectual blowing through of the vacuum vessels, as well as to save boiler room, it is proposed to generate steam in the boilers at 3 atmospheres = 45 lbs. above the atmospheric pressure. Hence required $\frac{1}{3}$ the full of one vacuum vessel of dense steam at 45 lbs. per three minutes. Now allowing $\frac{1}{10}$th of the volume of steam to be lost, which we shall hereafter show to be an ample allowance, we require every three minutes $19436 + \frac{19436}{10} = 21379$ cubic feet of steam at 212° Fah., which again is about equal to $\frac{21379}{3} = 7130$ cubic feet of steam at 45 lbs. per square inch, and $\frac{7130}{3} = 2376$ cubic feet of steam at same pressure is that required in one minute.

Now steam at this pressure gives about 620 volumes from one of water, hence $620 : 1 :: 2376 : 3\cdot83$ = cubic feet of water required to be evaporated per minute;—say 4 cubic feet per minute. Hence we get the following dimensions for the boilers, supposing those of the Cornish principle adopted. If locomotive boilers be used, four boilers of the common large size would be sufficient; but then the consumption of fuel per cubic foot of water evaporated would rise from 5·9 lbs. of coal to about 11·0 or 11·5 lbs. of coke.

Steam being generated at 45 lbs. in the boilers, we must (in order to obtain a rapid rush of steam into the vacuum vessels, and so discharge them of air with certainty,) not calculate upon the *continual* supply of steam, but provide a steam space in the boilers of rather more than one-third the capacity of one vacuum vessel, so that, on opening the steam-valve, they can be blown off at once into the vacuum vessel; allowing then, as before, $\frac{1}{10}$th of steam for waste, we have $\frac{21379}{3} = 7130$ cubic feet for the requisite steam space.

The results of experience in Cornish boilers prove that five boilers, each 6 feet 6 inches diameter, by 110 feet long, with a fire-grate surface of 72 square feet each, in two fire-places, one at each end of each boiler, will generate the required volume of steam, consuming 5·9 lbs. of coal per cubic foot of water evaporated from 70° Fah. into steam at 45 lbs. per square inch.

These five boilers will possess a steam space of 3500 cubic feet. The remainder of that required, viz., 3630, must be provided by steam chests placed upon the boilers.

Let us next consider if the allowance of $\frac{1}{10}$th of the whole volume of steam for waste is sufficient, which is 1943, say 2000, cubic feet of steam at each filling of the vacuum vessels; the sources of waste steam are:—

1. Cooling by radiation from the pipes and vacuum vessels.
2. Heating the cold air entering the vacuum vessels from the railway tube.
3. Blowing off at safety valves of boilers.
4. Leakage and blowing through at snifting valves.

The two last can only be guessed at; the first and second may be calculated approximately.

The surface of one pair of vacuum vessel cylinders = 2 cylinders of iron, 10 feet 6 inches diameter, by 124 feet long, assumed half an inch thick, which is double their proposed scantling, and adding, as usual, $\frac{1}{10}$th for angle and rivet iron.

10·5 diameter area of end = 87 square feet.
Circumference . . . = 33 ,, ,,
Hence, area of 4 ends = 348 square feet.
Cylinder surfaces = 124 × 33 × 2 = 9184 ,, ,,

9532 square feet.

which, at 20 lbs. per square foot, and adding $\frac{1}{10}$th, is =209704 lbs.; and as a cubic foot of wrought iron weighs 477 lbs. $\frac{209704}{477}=417$ cubic feet of iron. But ·0051 lbs. of coal will heat 1 cubic foot of iron 1° of Fahr. And assuming the utmost possible waste, or that the whole mass of iron representing the vacuum vessel were heated at first starting from 50° to 200° or 150° Fahr., then 0·765 lbs. of coal will heat 1 cubic foot of iron 150°, and hence $417 \times 0·765=319$ lbs. of coal.

But from the construction of these vessels no more than a thin film of pine timber of the lining will be heated to 212° at each filling with steam, so that probably the $\frac{1}{100}$th of the above, or the loss of 3 lbs. of coal, will be the outside of the waste at each filling with steam by cooling from the vessel itself. Now 3 lbs. of coal is represented by 607 cubic feet of steam at 212°. But we have a further loss of heat in the air, which entering the vacuum vessel at each period or stroke, (as we shall call each filling with steam, and condensation thereof,) must be heated by radiation from the vessel, and by the next entering steam from the mean temperature 50° to say 200°=150° Fahr.

The vacuum vessel holds 19436 cubic feet; let us assume this whole volume of air heated 150° at the first stroke, half of it at the second, and half of that at the third, &c.

Now ·00000184 lbs. of coal will heat 1 cubic foot of air 1 degree Fahr., hence ·000276. of coal to heat 1 cubic foot 150°; and $000276 \times 19436=5·364$ lbs. of coal to heat the whole volume at the first stroke 150°; half this, or 2·682 lbs. for the second, and half that for the third, &c.; but suppose the waste of the first stroke to continue all through, on the previous data, 5·364 lbs. of coal=1092 cubic feet of steam. So that it appears, after the apparatus is got to work, that 1699 cubic feet of steam is more than enough to meet the principal sources of waste, leaving 301 cubic feet of steam at each stroke for leakage and blowing through. Hence our allowance of $\frac{1}{10}$th the whole volume for waste is ample.

We have next to consider what amount of vacuum we can obtain by a given number of exhaustions of the vacuum vessels and equilibrations with the air in the railway tube. It is obvious that a vacuum-producing apparatus of this sort may be considered as an air-pump, in which the railway tube is the receiver $=r$, and the vacuum vessel the barrel of the air-pump $=b$; and that if the condensation of the steam give a perfect vacuum, the usual formula, $\frac{r^n}{(b+r)} d$ would represent the amount of rarefaction after n exhaustions, and that we may so consider the present case, applying to the results obtained suitable corrections for the three following sources of deduction from the amount of vacuum, viz.:—

1. For the tension of aqueous vapour due to the temperature of condensation, this being determined at 70° Fahr., is =0·726 inches of mercury. This amount of deduction for vapour is too great, for the limit of tension of vapour will be, after a few seconds, that due to the *coolest* part of the apparatus; but this is the railway tube, which is always in connexion with one vacuum vessel; and as the temperature in this would probably never be above 60°, and its average below 50°, the real tension of vapour to be calculated on would be due to those temperatures.

2. For the volume of combined air liberated from the condensing water, and carried in by the steam. Rain water contains from $2\frac{1}{2}$ to 3 per cent., say 5 cubic feet of air for every 100 feet of water introduced to the condenser.

3. For the expansion of the air from the railway tube entering the vacuum vessels and becoming heated, and hence practically *less* entering at each stroke than is due to the capacity of the vessel and difference of pressure. Air expands $\frac{1}{480}$ of its volume for 1 degree Fahr. or more correctly according to Rudberg $\frac{1}{493}$; but take the larger expansion, and assume that the air entering the vacuum vessels from the tube gains 20° Fahr., then $\frac{20}{480}$=its expansion$=\frac{1}{22}$. But the effect of this is tantamount to diminishing the capacity of the vacuum vessel, or the value of b $\frac{1}{22}$ part; so that if the capacity of the railway tube be in this case represented by 200, that of the vacuum vessel will be=say $100-(\frac{1}{22}$ say $\frac{1}{5})=95$. To this another small correction should be made for the air of the railway tube becoming saturated with vapour on entering the vacuum vessel; this may however be neglected.

In order to obtain the value of our second correction, we must now determine the volume of condensing water required for each stroke or period. We

have already found that 7130 cubic feet of steam at 212° Fahr. is required to be condensed per minute. Let

L = the sum of the latent and sensible heat of steam at the given temperature = 1212°.

t = the temperature of the condensing water.

T = its temperature after condensation.

c = the cubic feet of steam.

Then $\frac{L-T}{T-t} \times C = Q$, the volume of condensing water at the temperature t, in cubic inches.

The volume of condensing water, therefore, required for one stroke or period, at the following temperatures, is

Temperature.	Cubic feet per min.	Cubic ft. 1 stroke, or in 3 min.
50° Fahr. . .	235 . .	705
40°	151 . .	453
32°	120 . .	360

And as each 100 cubic feet of water is supposed to involve 5 cubic feet of air, there will be evolved in one stroke or period, at

50° Fahr . .	35·25 cubic feet
40° . . .	22·15 ,,
32° . . .	17·80 ,,

This air we may suppose introduced to the vacuum vessel dry, and as it will become saturated with vapour at 70°, from the moist sides of the vessel, its bulk will be enlarged; but inasmuch as we have taken 5 per cent, in place of 2½ or 3 per cent. for the air evolved, and as in most cases the condensing water will not even contain this much, and may be used over again, and so evolve scarcely any, it is not worth while to apply this correction. Hence, taking the nearest whole numbers above the preceding, and as the evolved air will always occupy one vacuum vessel and the condenser together, whose united capacity is = 29154 cubic feet, we have at the first stroke, and with the above temperatures of condensing water, the following values for the air evolved in terms of the vessels' capacity:—

$$50° \text{ Fahr.} \quad \frac{29154}{36} = \frac{1}{809}.$$

$$40° \text{ ,,} \quad \frac{29154}{23} = \frac{4}{1267}.$$

$$32° \text{ ,,} \quad \frac{29154}{18} = \frac{1}{1619}.$$

The amount of vacuum, therefore, will be diminished by this amount at the first stroke, and n times this for n strokes; and taking 30 inches to represent the whole vacuum, we get the following table of the amount of deduction due to evolved air at each of the first eight strokes for the three above given temperatures of condensing water.

Strokes.	Temperature 50°. Inches of mercury.	Temperature 40°. Inches of mercury.	Temperature 32°. Inches of mercury.
1	0·037	0·0237	0·0185
2	0·074	0·0474	0·0370
3	0·111	0·0711	0·0555
4	0·148	0·0984	0·0740
5	0·185	0·1185	0·0925
6	0·222	0·1422	0·1110
7	0·259	0·1659	0·1295
8	0·296	0·1896	0·1480

It thus appears, where the capacity of the vessels is so large, that up to the eighth stroke this correction is quite unimportant, even with condensing water at 50° Fahr., and supposing the whole of the air evolved to remain in the vessels. But, as at each succeeding stroke the vacuum vessels are filled with steam, *two-thirds* of the whole quantity of air evolved from the condensed water of the preceding stroke is blown out; and hence the actual depressions of the vacuum gauge would only be one-third of the values in the preceding table, or insensible until after about 80 strokes, when the condenser itself would have to be cleared of air by blowing through.

And thus it appears, that the larger the vacuum vessels can be made in capacity the better; the limit of size being wholly dependent upon practical considerations of construction, and upon the power of rapid supply of steam to fill them. In the present case we have provided a capacity such that eleven trains may be passed before it becomes necessary to clear the condenser of air; it is therefore plain, that if this operation were performed at every fifth train, the vessels might be of only one-half the capacity here assigned. The generating power of the boilers being still the same, the rapidity of producing vacuum would be but little diminished. The question, however, of the most advantageous possible *size* of vessels under given conditions, is one requiring further investigation, based upon certain experiments, which require to be made.

(To be concluded in our next.)

ON THE CHEMICAL CHANGE PRODUCED BY SOLAR RAYS. BY MR. ROBERT HUNT.

[Being the substance of a communication to the Royal Cornwall Polytechnic Society.]

After drawing attention to the very extensive and curious discoveries, which had been made during the past years, in the chemistry of solar radiations; the author proceeded to show, that these effects were not confined to the ordinary photographic preparations, but that they extended over a large series of the chemical compounds. In the first place, he drew attention to the accelerating influence of the sun's rays on precipitation. It was found that the sulphate of iron being dissolved in water containing a little carbonic acid, precipitated a considerable portion of the carbonate of iron, when it was exposed to sunshine; but that *in the same* time a similar solution in the dark gave no evidences of precipitation. An effect similar to this had been observed by Sir John Herschel, on a solution of lime and platinum, from which an insoluble platinate of lime was formed in the sunshine, but not any in the dark. A mixture of the iodide of potassium and the ferro-prussiate of potash, being exposed to good sunshine for a few hours, a decomposition was effected, and a considerable quantity of prussian blue was precipitated; in the dark the same mixture underwent no such changes. Several other similar cases were named, which Mr. Hunt intends still further to investigate.

The effect of light on the colour of precipitates was next mentioned. It has long been observed by the French manufacturers of carmine, that that very beautiful preparation was procured of a much richer colour, if it was prepared in the bright sunshine, than if prepared in the dark, or on a gloomy day. Mr. Hunt had discovered that the chromates of silver and mercury as well as prussian blue, varied very much in colour, if they had been exposed during their preparation to the influence of the sun's rays, or otherwise.

A still more remarkable effect had been observed by the author, which appeared to indicate some absorption of the principle upon which these changes depend. It is well known to chemists, that a solution of sulphate of iron will precipitate gold and silver in a metallic state from their solutions. In the dark this process occupies many hours—and even in diffused daylight a considerable time. If, however, either of the solutions—either the iron, or the silver, or gold—be exposed to solar influence for some time, they undergo a change by which the precipitation of the metal is immediately effected, *even in the dark*. It is not necessary that both solutions should be exposed; the iron solution alone is quite sufficient. May we not then suppose that the principle producing these curious chemical changes, is absorbed by the fluid during the period of its first exposure?

A small galvanic arrangement having been made by placing a tube, closed at one end with a skin diaphragm, in a large test glass; a solution of the iodide of potassium was poured into the tube, and a solution of nitrate of silver was put in the outer glass—the two fluids being connected with a piece of platinum wire. An arrangement of this kind being placed in the dark, in about four hours a very beautiful crystallization of metallic silver was found to have taken place about the platinum wire in the silver solution. Another arrangement, in every respect prepared in the same manner, was exposed to sunshine. Not only did no metallic crystallization take place whilst exposed, but the exposure had so changed the character of the solution, that no such crystallization would afterwards take place, even in darkness. This experiment was many times repeated, with various modifications, but always with the same result. Here we have a very striking instance of the interference of the solar radiations, with the exercise of the force of galvanic electricity. It is not improbable, but these may be made measurers of each other; knowing the force of the current generated between the two solutions, it will not be difficult to ascertain the quantity of the solar rays necessary to retard or stop the action of that force.

Another experiment was as follows:—a solution of the bichromate of potash, and a solution of the sulphate of copper being mixed together, were exposed to the sunshine, and such light as might prevail during the month of November. A similar solution which had not been so exposed, was evaporated, and crystals obtained of a rather curious character. They were sulphates of copper and potash, and salts of chromium, which had not been previously described. On evaporating the solution, which had been exposed to the sunshine, it was found that the characters of the crystals were completely changed, as far as chemical combination was concerned. The relative proportions of the constituents being in each case very materially changed. Similar results had been obtained with solutions of the bichromate of potash, and the chlorides of gold, and of mercury. The investigation is not, however, yet complete. Mr. Hunt exhibited several specimens of the salts prepared from both the exposed and the unexposed solutions.—*Annual Report of the Royal Cornwall Polytechnic Society*, 1844.

Sir,—From Mr. Curtis's observations, at the Institution of Civil Engineers, in the discussion after Mr. Guppy's interesting paper as to the uncertainty of measuring a ship's velocity by the common log, I am induced to obtrude my invention once more upon your notice, as being an exceedingly simple mode of ascertaining to a great nicety the relative performances of steam vessels, and also as a substitute for the log. Fig. 1 is a side view, and fig. 2 an end view of this instrument. A is a small wheel, 1 foot diameter, having vanes set at such an angle, that, when let into the water, the action upon their inclined surfaces would cause the wheel to revolve once in passing the distance of two feet through the water. Upon the axis of the wheel is an endless screw, *a*, into which works a small toothed wheel, having 51* teeth. The instrument should be mounted on the low end of a stiff bar of wood, or other material, of such length, as that the top end could be fastened by a joint or hinge, *b*, to the side of a vessel, in convenient proximity to a cabin window, or to the deck. To the low end of the rod or bar a small line should be attached, *c*, the other end of which to be secured on the deck of the vessel. The use of this line would be to withdraw the instrument from the water, when not required for observation, and to lash it horizontally out of the reach of the waves. When the line was released, the instrument should be so suspended as to fall perpendicularly into the water, and the bar sufficiently stiff to remain perpendicular, and resist the pressure of the water against its front edges, which, however, would be but trifling. The axis of the small toothed wheel should be enclosed in a tube in front of the bar on which the wheel is suspended, and prolonged to a short distance below the hinged joint; and upon the top end of it should be fixed an index, *d*, to revolve on a dial-plate decimally divided. The wheel being constructed as before described, this index would make one revolution round the dial-plate in the time that the vessel passed 102 feet through the water, which is about the

Fig. 2.

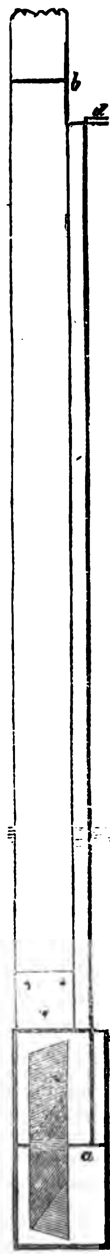
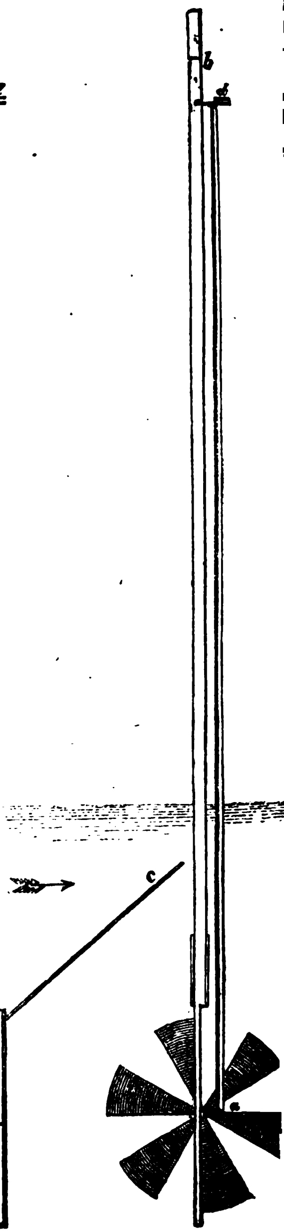


Fig. 1.



* Probably 50 teeth would be better.

one-sixtieth part* of a knot, or nautical mile. If, therefore, an observer stood with a minute glass (or seconds watch), and turned the glass the moment the index was at zero upon the dial plate, and noted the number of revolutions and parts made by the index during the time the sand was running out, he would have the rate at which the vessel passed through the water, in knots and decimals, per hour.

I have now by me a small wheel constructed as here described, which I should have great pleasure in forwarding for the inspection of any person interested therein. This wheel has eight vanes, which are retained at their proper angle by a ring which surrounds them; but I think *six*, or probably a less number, would be sufficient, and that they might be made sufficiently strong to retain their shape without the ring, which would reduce the friction. In a steam vessel this instrument should be fixed before the paddles.

I hope the accompanying sketches will be sufficiently explanatory.

I am, Sir,
Yours respectfully,
BENJAMIN BIRAM.

Wentworth, September 17, 1845.

CYLINDRICAL AND CONIC SECTIONS.

Sir,—I beg to correct an error in my last. I have there stated that the winding intersection of the solids adverted to, cannot have more than *three* points on the same plane. I ought to have said, may have always three points on the same plane.

In the intersection (alluded to in vol. xliii. p. 143) of the cylinder and cone, there may be *four* points of the curve of intersection on the same plane.

The number of points that may be in the same plane, of winding curves of intersections, may be an important matter in the mathematical consideration, in the projection of the whole, or part of such a curve on a plane, and in the mechanical application of the motion, by which such lines can be drawn.

In the case just alluded to, the axis of the cylinder and the axis of the cone are in the same plane, and the curve of intersection is in two parts symmetrical. But, if the axis of the one is on a different plane to the axis of the other, the line of intersection will be dis-symmetrical. Without having a sufficient number (perhaps some hundreds) of cones and cylinders intersected in the various distinct ways they will admit of, and these on a sufficiently large scale, (and also transparent, would be desirable,) it is difficult to comprehend, and more difficult to describe, the exact appearance of every distinct line of intersection as it might be projected at different angles; or from one of the curves of the "Septenary System," to show in what way a cylinder and cone should be intersected, so that viewed or projected at some angle the intersection would be the same line.

With a sufficient number of these practical intersections, the difficulty would be removed, and correct rules deduced for practical applications.

I am, Sir, yours, &c.
JOSEPH JOPLING.

29, Wimpole-street, Sept. 17, 1845.

* Rather more.

THE AMERICAN FRIGATE "PRINCETON."

[Extract from Report of Committee of the American Institute appointed to examine this frigate.

The ship is 164 feet in length, 30 feet beam, 22 feet hold, making her about 700 tons measurement. She draws 17 feet of water aft, and $14\frac{9}{12}$ feet forward. The peculiarity of her construction is great sharpness of entrance and run, with nearly flat floors midships, which effectually prevent her being crank, notwithstanding the great weight of her battery.

The most obvious peculiarity of the *Princeton's* model is the great extent of her dead-wood, terminating with a sternpost of unusual thickness, being 26 inches through at the centre of the propelling shaft, but tapering both above and below. The object of this uncommon form is to give sufficient strength to the stern-post, as a hole of 13 inches diameter passes through it, in which the propeller shaft revolves. The stern-post also requires unusual strength, because the bearing which supports the whole weight of the propeller is attached to it, the shaft having no bearing abaft the propeller. The rudder is of an entirely novel construction, consisting of a frame of wrought iron, filled in with 5-inch pine plank, the whole of

which is cased with copper plates, three-sixteenths of an inch thick, thus making the entire thickness of the rudder $5\frac{3}{8}$ inches. The mode of supporting the rudder is equally novel. It is hung to an outrigger of wrought iron, covered with half-inch copper plate, the upper part being attached to a strong oak knee under the counter, and the lower part being attached to a solid frame of oak timber, 3 ft. 6 in. wide, and 14 inches deep, firmly bolted to the after part of the keel, and dead-wood of the ship. The thickness of the outrigger is $5\frac{3}{8}$ inches, the same with that of the rudder, measuring 2 feet fore and aft, the forward part being made as sharp as a ploughshare. This sharpness, and the thinness of the rudder, prevent the current produced by the propeller from retarding the progress of the ship.

Your Committee examined with particular interest and attention the steam-engine of the *Princeton*, which excited their admiration no less by the novelty of its construction than by the perfect symmetry and beauty of its proportions. It is styled by the inventor and patentee, Capt. Ericsson, the 'Semi-cylindrical Steam-engine.' It has been constructed apparently with two main objects—that of being placed entirely below the water line, and of giving a *direct* motion to the propeller shaft, which requires a greater velocity than can be obtained by the ordinary engine. These objects have been fully accomplished; indeed, so compact is the engine, that its highest point is placed more than 4 feet below the water line, and so far below the berth deck that it affords space for lodging from 2 to 3 feet of coal above it, as well as on the sides.

The peculiarity of this engine consists in the use of semi-cylinders instead of entire cylinders. These semi-cylinders are 72 inches in diameter, and 8 feet long. The pistons are parallelograms attached to wrought iron shafts, forming the axis of the semi-cylinders, and are made to vibrate through an arc of 90 degrees, by the admission of steam alternately on opposite sides, ordinary slide valves being employed for that purpose. The piston-shafts pass through stuffing-boxes at each end of the semi-cylinders; and at the forward ends crank levers of 34 inches throw are attached, which, by means of connecting-rods only 74 inches in length, give motion to the main crank of the propeller shaft. The active surface in each piston measures 96 inches by 26, presenting an area of 2496 inches. The centre of pressure of each piston moves through an arc of precisely 36 inches, and thus the *Princeton's* engines have equal power with two ordinary marine engines having cylinders of $56\frac{3}{8}$ inches diameter and 3 feet stroke.

At the opposite ends of the piston shafts, crank levers of 16 inches throw are attached, for the purpose of giving motion to the air pumps and force pumps. Your Committee cannot refrain from noticing particularly the ingenious disposition of the working parts connected with these pumps, and the remarkably simple mode by which the requisite parallel movements are obtained.

The maximum speed of the engines is thirty-seven revolutions per minute. The maximum pressure of steam in the boilers is twenty-five pounds to the square inch; and the steam in the semi-cylinders is invariably cut off at one-third of the stroke. The greatest speed of the vessel, as ascertained by Captain Stockton in the *Delaware*, has been nearly fourteen statute miles per hour. At the ordinary speed of twelve miles, the consumption of fuel has been found to be eighteen hundred pounds per hour.

It is necessary only to allude to the propeller of the *Princeton*, constructed by Capt. Ericsson, and identical with that now so successfully employed in various parts of the country. This propeller is manufactured of composition metal. Its extreme diameter is 14 feet, and the upper part is full 3 feet below the water line.

The boilers of the *Princeton* are also placed below the water line, and resemble those of the ordinary marine engines; but their furnaces and flues are so constructed as to burn anthracite as well as bituminous coal.

Attached to the boiler is a heating apparatus possessing very remarkable properties, by which the water feeding the boilers is constantly heated before entering the same. Your Committee view this apparatus as perhaps the greatest improvement of which the low pressure engine for ship use is susceptible. It not only continually supplies the boiler with hot water, but enables the engineer, when at sea, to 'blow off' very freely, without any material loss of pressure or expenditure of fuel.

The smoke-pipe of the *Princeton* is constructed upon the principle of the telescope, and may be elevated in lighting the fires, o when it is desirable to work the engine with natural draft. The contrivance mad for this purpose is efficient, being a simpl application of the endless screw, turned by crank; and it enables two men to rais and lower the chimney with great facility precluding the possibility of an accide from negligence, as the smoke-pipe will re main stationary, whenever the men at th

hoisting apparatus discontinue working it. The successful introduction of this sliding smoke-pipe, and the means for elevating and depressing it, must be considered a complete solution of one of the many problems connected with naval warfare hitherto unsolved.

The fire draught is independent of the height of the smoke-pipe, being promoted by centrifugal blowers placed in the bottom of the vessel, and worked by separate small engines. Thus the steam machinery of the *Princeton* realizes all that can be desired for a war steamer, as the whole of it is placed out of the reach of the enemy's fire.

Your Committee would do great injustice to the manufacturers and the vast progress in the mechanic arts, recently made in the United States, if they omitted to refer, in language of the highest pride and gratification, to the beautiful workmanship and execution of the steam machinery of the *Princeton*. It more than rivals—it surpasses—the machinery of the trans-Atlantic steam ships. It was built by Messrs. Merrick and Towne of Philadelphia.

The armament of the *Princeton* consists of twelve 42 pound carronades, and two 212 pound Stockton guns. These last are made of wrought iron, said to have been thoroughly proved, and all are placed on the upper or spar deck. One of the Stockton guns, weighing fourteen thousand pounds, is placed eight feet forward of the mizen-mast, and in a line with it; the other, weighing twenty-three thousand pounds, is placed at the bow*. Both are mounted on carriages traversing on beds of timber, which are secured in the centre by strong pivots, around which they turn. These beds are supported by four friction rollers, inserted in the four corners, and travelling on a flat ring of composition metal let into the deck. The bulwarks, being moveable and very light, are readily unshipped, to give full play to the large guns in the direction required.

The carriages are made entirely of wrought iron, each side being composed of two plates, $\frac{3}{16}$ths of an inch thick, $4\frac{1}{2}$ inches apart, and connected by a series of stay bolts. In the space between the two plates, a simple mechanism is ingeniously concealed, which enables four men with the utmost facility to roll the guns back and forward on the beds, and removes altogether the anticipated difficulties in managing ordnance of such immense calibre. It need hardly be stated that the difficulty of checking the recoil attending the heavy charge necessary for such a piece is even greater than that of moving the gun, and here again mechanical skill has triumphed to all appearance over the supposed insuperable obstacle. The ordinary breeching is entirely dispensed with, and the recoil is checked by opposing a gradually increasing friction to the carriage on which the gun is mounted. The means employed for this purpose exhibit a happy application of one of the fundamental principles of mechanics—that of the inclined plane, in connexion with the laws of friction; and so successfully has this principle been applied, that although the friction apparatus, at the termination of the recoil of the gun, becomes what is technically called *jammed*, with a force perhaps of many millions of pounds, yet by slightly touching a lever, it becomes instantly disengaged, leaving the gun and carriage perfectly free. A contrivance having the same object in view is applied to the carronades, which in them also dispenses with the ordinary breeching.

In connexion with the Stockton guns, besides the carriage, &c., of which they have spoken, your Committee have to notice two other contrivances, which render them unquestionably the most formidable ordnance ever mounted. Of these, the first is a lock so constructed that it is discharged at any desired elevation, without human interference, by a peculiar mechanism, in which the law of gravitation, in connexion with the rolling of the vessel, is rendered subservient to this purpose. The second contrivance referred to is an instrument to measure distances, by which the requisite elevation to be given to the gun may be instantly determined.

Your Committee would mention that the heaviest of the Stockton guns was forged in the city of New-York, by Messrs. Ward and Co., and was bored and finished by Messrs. Hogg and Delamator, of the Phœnix Foundry. It is composed entirely of American iron, and is, beyond comparison, the most extraordinary forged work ever executed in this or any other country.

The *Princeton* is sparred and rigged in the ordinary manner of sloops of war. All the modern improvements of our packet ships have been adopted, and in some cases simplified. It is therefore believed, that as a sailing ship, without reference to her engines, she will be found to be very fast, and to excel in that respect anything of her size yet built for our Government. This quality will enable her to keep the sea as long as any other corvette, and at no greater expense—

* It was the last of these guns that subsequently exploded, (see *Mech. Mag.* vol. xlii., page 47,) and which has been since replaced by a gun of the same size, but better metal, manufactured by Messrs. Fawcet, Preston, and Co. of Liverpool.—Ed. M. M.

her fuel, like her powder, being reserved for an emergency.

* * * *

In conclusion, your Committee take leave to present the *Princeton* as every way worthy the highest honours of the Institute. She is a sublime conception, most successfully realized—an effort of genius skilfully executed—a grand *unique* combination, honourable to the country as creditable to all engaged upon her. Nothing in the history of mechanics surpasses the inventive genius of Captain Ericsson, unless it be the moral daring of Captain Stockton, in the adoption of so many novelties at one time.

ON THE USE OF CAST AND WROUGHT IRON BEAMS IN BUILDINGS.

From Report by Sir Henry Thomas de la Beche and Thomas Cubitt, Esq., Commissioners appointed to inquire into the Fall of the Cotton Mill at Oldham.

"We abstain from all remark as to the forms which may at present appear best adapted for cast-iron beams, further than to observe that when calculations as to the strength of such beams are founded on the supposition that the cast-iron employed is of uniform texture, it would appear difficult to obtain this homogeneity except in castings of nearly uniform thickness in the various parts; that when cast-iron beams are suddenly removed red-hot from the sand in which they are cast, we should expect them to be comparatively brittle, however good the iron may otherwise be; and that some efficient proof of cast-iron beams is most desirable before they are employed in buildings, since, assuming effective forms and the use of good iron, every care having been taken to cool them properly, flaws may exist, not visible externally, rendering them unfit to support the weights they are intended to sustain.

"We are desirous of observing that, although in districts viewed on the large scale, certain differences in the original quality f the cast-iron manufactured may exist, marked by corresponding differences in the market value, much caution should be employed when consulting tables presenting the results of experiments as to the strength of iron from particular works, since, as it is well known to those who are engaged in this manufacture, that even the same furnace may afford different qualities of iron at different times, though only one quality may be desired. Hence injustice may often be done to those engaged in such works, should inferior qualities of iron be considered as always produced at these establishments because at the time of given experiments their cast-iron may not have been found amongst those exhibiting fair average strength, less care in the manufacture at one time than another, or a change of the persons superintending the furnaces, being sufficient to produce corresponding differences in the quality of the product from similar materials.

"While on the subject of cast-iron for beams, we would state our strong conviction, founded on a general view of the subject, of the importance of substituting wrought-iron for cast-iron, whenever it can be accomplished, and we anticipate that wrought-iron will be rolled into a sufficient size for all the uses to which large cast-iron beams are now applied, judging from the present size of rolled pieces of iron. When this shall have been accomplished a great advance will have been made in the use of iron, seeing that beams, or other large pieces of that metal may, with confidence, be relied upon. We consider that when wrought-iron can be thus rolled and employed, its use will become most extensive, and that the consumption of iron for building purposes would be greatly increased, to the benefit of an important branch of our national industry."

Extract from Supplementary Report by Mr. Cubitt.

"I would further humbly represent to your Majesty, that, since the first introduction of iron into buildings, its use has progressively increased; and considering that it is desirable to encourage the erection of buildings that are composed of incombustible materials, affected as little as possible by the changes of weather from dryness to humidity, and free from the effects of dry rot, or the ravages of vermin, and cast-iron at present being one of the principal materials by which these advantages are conveniently secured, there is, it must not be disguised, great danger to be apprehended in its use, in consequence of our limited and imperfect knowledge of its qualities and properties.

"Buildings constructed with floors of wood, though at the mercy of an incendiary, and subject to many inconveniences, have, at least, this one advantage, namely, that an injudicious application of it in their construction is to be less dreaded than when cast-iron is the substance employed.

"Wood being much more elastic, receives without injury shocks which would be fatal to cast-iron; while its great flexibility adapts it to give warning of its own insuffi-

ciency, or of an undue pressure acting upon it, perhaps in time to avert danger; whereas cast-iron, from its nature, is incapable of affording the like demonstration of its weakness; and the fall of a building so constructed, from the weight and solidity of the material, is likely to be attended with far more disastrous consequences.

"Yet, notwithstanding the many casualties to which cast-iron is liable, its introduction into buildings has been a great gain; and I believe that fewer accidents have happened, with all its disadvantages, than might have been reasonably expected. And buildings very essential to the safety of the inhabitants of thickly-peopled towns, affording security against the devastations of fire, either by diminishing the risk of its first outbreak, or cutting off the communication with the adjacent burning houses, in order to stop the progress of the flames, could not be constructed conveniently, adapted to the purposes of trade, or for public rooms, without the use of iron,

* * * *

"Much, if not all the risk involved in using iron for beams would be avoided, by the substitution of wrought for cast-iron; but, up to the present time, the anxiety for this change is not widely enough diffused to lead to any immediate practical result in the manufacturing of wrought-iron beams of such dimensions as are applicable to buildings of the largest size. And it may be remarked, that the larger the building is, there is generally greater danger of failure, with more deplorable results; consequently, the more urgent need there is for increased precaution in providing a corresponding amount of strength, the greater are the difficulties at present experienced, at least as regards wrought iron.

"The expenses necessary to the production of large masses of iron, rolled in the form of beams, being more than a private individual might feel himself justified in incurring for his own use, and the demand from an inadequate conception of their value not being sufficiently pressing or extensive to secure the manufacturer from loss, it is to be feared that it will take some time yet before we shall be in possession of the many advantages which it may be expected will result from their manufacture, unless some stimulus be given in order to hasten the attainment of this very desirable object.

"I therefore humbly suggest for the consideration of Your Majesty the expediency of devoting 1,000*l*. or 1,500*l*. to this purpose, and would propose that premiums of such sums as it may appear advisable, be offered for the best and strongest rolled-iron beams, calculated for the use of floors, to sustain a load not under 25 tons, with bearings not less than 24 feet apart.

"And in order to ensure a steady progress in the improvement of the manufacture of iron generally, perhaps an exhibition once a year of the best samples with new forms, will forward the attainment of this end. Such samples might be tested in a proving house, which it may be thought expedient to establish for the accommodation of the public generally, where parties may be allowed to have beams or chains proved at a moderate expense, by which the value of the commodity and its fitness for the proposed work may be ascertained.

"The cost of apparatus for proving beams only, being heavy, and requiring much practice in order to make such fully available and to arrive at correct results, it follows that those persons only who are extensively engaged in building, provide themselves with means for testing the strength of iron beams, whilst those whose use of them is occasional, have no convenient opportunity of proving them; and it would seem that such persons have greater need of this sort of assistance than those who, from their extensive practice, become more conversant with the general strength of iron.

"I would, therefore, beg leave to recommend for the consideration of your Majesty's Government, the expediency of providing a proving house, if not in every large town, at least in London, where any person might send their beams and rely upon their being correctly tested.

"I believe that if facilities were furnished for getting wrought-iron of large dimensions, very few large timbers would be used in building; and as iron can be produced in unlimited quantities, and the whole of the cost of its production spent in employing the labour of this country, the benefit it would produce could hardly be calculated; for, in addition to that required for our own use, an immense demand would grow up for exportation, as it would provide the means of making safe and durable fire-proof buildings—what every person desires, but which at present is very difficult to attain.

"Thus the community at large would be benefited by an extended manufacture of wrought-iron, and particularly all the public works under the immediate control of your Majesty's Government. All buildings, whether used as storehouses, barracks, or hospitals, might be rendered more safe and more permanent. Large beams of wrought-iron might be very advantageously employed in ship-building generally, and more especially for supporting the decks over the

boilers of steam-vessels. And, to conclude, another step would be taken in order to secure to this nation that pre-eminence it has hitherto maintained in the manufacture of iron."

PHOTOGRAPHY.—METAL SPECULA.

Sir,—When Mr. Cumberland's letter appeared in your *Magazine*, I had then intended to have made a reply, but the letter of "Homo" has nearly included all that I could have said. The speculum and its properties are known to almost every amateur in photography. It is now about three years ago that I first saw a metal speculum, of Sheffield manufacture; but I have not in practice found them answer the intended purpose: they certainly facilitate the painful operation of sitting with that death like stillness so essential for a good sharp image; but, as a set-off against that, they *burn* or solarize the plate, and of course destroy the tint so requisite to Daguerreotype. Glass specula no doubt give double images, in spite of all that has been said to the contrary. We may, nevertheless, misunderstand Mr. C. in the kind of arrangement he did mean to favour your readers with; if so, Mr. Cumberland will no doubt give a more explicit description. A. B. C.

P.S. *En passant*, can any of your readers give any information about the *great unknown* lenses that came from Germany some twelve months (or may be more) ago? I have somewhere heard or read of three sets, one pair at 60*l.*, ditto 80*l.*, ditto 100*l.* Now, if the highest price for good German lenses has hitherto only been 6*l.* or 7*l.*, what must be the properties of these monstrous priced ones? If we take the thing arithmetically, it would amount to about the value of St. Paul's to a China orange.

THE KING OF OUDE AND SCREW PROPELLING.

Sir,—In perusing the colonial edition of Bishop Heber's Indian Journal, I find he states (page 219, vol. ii.) in speaking of the King of Oude, the following:—"At this breakfast he was more communicative than he had been, talked about steam-engines, *and a new way of propelling ships by a spiral wheel* at the bottom of the vessel, which an English engineer, in his pay, had invented."

From the above paragraph I am led to conclude that the application of the Archimedean screw to the purposes of propulsion, is not, as is generally supposed, the original idea of Mr. Smith, but may more fairly be claimed by this engineer, of whom Bishop Heber so ingenuously speaks.

I may add that Bishop Heber's tour across India took place in 1824 and 1825.

I am, Sir, your obedient servant,

J. D. L.

Jermyn-street, St. James's, 25th September, 1845.

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Guildhall, London, Sept. 15.

Mr. DENTON, a paper-stainer, in Leadenhall-street, was summoned before Aldermen KELLY and MOON, to answer an information, filed on behalf of Mr. BOSWELL, a paper-stainer, in Dublin, for selling a fraudulent imitation of a registered design for paper-hangings, the property of Mr. BOSWELL.

Mr. CLARKSON attended to support the information, and Mr. PELHAM appeared for the defendant.

Mr. CLARKSON stated the nature of the provisions of the Act respecting the registration of certain original designs, and that Mr. Boswell registered a new pattern for paper-hangings on the 8th of February, 1843. After some time he found his pattern had been copied by a London manufacturer, and was being sold in Dublin. He proceeded against that person, and obtained a conviction; and he gave notice to the defendant to desist from manufacturing it. The defendant wrote back a letter, in which he said he could prove that the pattern had been copied from a Parisian manufacturer, and was not original, or if it was, that it had been published before it was registered, and therefore was not entitled to registration.

Mr. Alderman MOON asked if this was not properly a question for the Court of Chancery?

Mr. CLARKSON said he was sure the alderman was, like himself, one of the last persons who would advise anybody to get into Chancery who could possibly keep out of it. The very object of the law was to give a small tradesman a speedy relief at a small expense, in cases of piracy upon some invention or improvement he had registered.

Evidence was then adduced to prove that the defendant had printed and sold paper exactly corresponding in design with the design registered by the complainant.

After which Mr. Alderman Kelly and Mr. Alderman Moon consulted together, and pronounced the defendant's paper a fraudulent imitation of Mr. Boswell's, and fined the defendant 5*l.*

Mr. Denton promised he would sell no more of the paper.

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC., CAP. 65. FROM AUGUST 28 TO SEPTEMBER 23, 1845.

Date of Registration.	No. in the Register.	Proprietors' Names.	Address.	Subject of Design.
Aug. 28	526	Thomas Masters	56, Upper Charlotte-street, Fitzroy-square	Machine for cleansing forks.
29	527	John Paterson	104, Wood-street, Cheapside	Cravat collar.
"	528	James Wilson	37, Walbrook	Apparatus for shaping and stretching hats.
"	529	Edward Highton	Cardiff, South Wales	Railway chair.
Sept. 3	530	William Wadman	Bristol	Flat flame shadowless gas lamp.
"	531	William Hutton and Son	Sheffield	Penholder.
"	532	Brookes Hugh Bullock	2, Chester-street, Grosvenor-place, Middlesex	Distance measurer for maps, charts, &c.
"	533	Francis Higginson	St. Margaret's Bank, Rochester.	Apparatus for extinguishing accidental fires in dwelling-houses, and other buildings.
6	534	W. C. Wilkins, and S. M. Kendrick	Long Acre	Improved spirit lamp.
12	535	Simon King	Upper Thorpe, Sheffield	Ventilating and smoke-consuming stove grate.
"	536	Geo. and Jno. Deane	46, King William-street, London Bridge	Coffee-pot (the Shilos).
13	537	Joseph Gimbert	59, Hatton garden	Clip or holder, for holding invoices, music, letters, and other papers.
23	538	Thomas Jones	Holly Lodge, Hanwell	Expanding and collapsing box, or packing-case,

LIST OF ENGLISH PATENTS GRANTED BETWEEN AUGUST 28, AND SEPTEMBER 25, 1845.

Alfred Vincent Newton, of Chancery-lane, mechanical draftsman, for certain improvements in machinery for manufacturing India rubber fabrics. (Being a communication.) August 28; six months.

William Edward Newton, of Chancery-lane, civil engineer, for improvements in machinery or apparatus for spinning. (Being a communication.) August 28; six months.

Mathieu Francois Isoard, of Paris, for improvements in obtaining motive power. August 28; six months.

John Vaux, of Frederick-street, Gray's-inn Road, gent., for improvements in apparatus for warming boots and shoes. September 4; six months.

Henry Samuel Rayner, of Ripley, Derby, gent., for certain improvements in locomotive engines. September 4; six months.

Henry Bewley, of Dublin, chemist, for certain improvements in flexible syringes, tubes, bottles, hose and other like vehicles and vessels. September 4; six months.

Charles Lampitt, of Banbury, engineer, for an improved dibbling machine. September 4; six months.

Alexander Haig, of Great Carlisle-street, Portman-market, engineer, for certain improvements in machinery for ventilation and other similar purposes, to which the said machinery can be applied. September 4; six months.

Elisha Haydon Collier, of Goldsworthy-terrace, Rotherhithe, engineer, for certain improvements in the manufacture of nails, and in the machinery or apparatus to be used for such purposes. September 11; six months.

Henry Mandeville Meade, of New York, America, for improvements in distilling from Indian corn and other grain. September 18; six months.

Joseph Francois Lambercan, of Paris, gent., for improvements in obtaining power. September 18; six months.

Charles Hodgson Horsfall, of Liverpool, merchant, for improvements in the manufacture of iron. September 18; six months.

William Eccles, of Blackburn, power-loom manufacturer, William Cook, of Livesey, hand-loom weaver, and William Lancaster, power-loom weaver, of Blackburn, all of Lancaster, for certain improvements in looms for weaving. September 18; six months.

Charles Minland, of Castlewellan, Ireland, flax spinner, and Edward Lawson, of Leeds, machine maker, for certain improvements in machinery for preparing and spinning flax, and other fibrous substances. September 18; six months.

James Polkinghorne, the younger, of Hoxton, gent., for certain improvements in treating ores, and in separating from them the metals which they contain. September 18; six months.

James Caldwell, of Broad-street, Radcliff, engineer, for improvements in ships' riding bits, and in windlasses. September 18; six months.

Stephen Higginson Perkins, of Charlotte-street, Bedford-square, for certain improvements in the steam engine, and in its application to steam navigation. (Being a communication.) September 18; six months.

Edward Ghrimes, of Rotherham, brass founder, for improvements in cocks and taps. September 25; six months.

LIST OF PATENTS GRANTED FOR SCOTLAND, FROM THE 22ND OF AUGUST TO THE 22ND OF SEPTEMBER, 1845.

George Meyers, of Lawrie-terrace, Westminster-road, Lambeth, builder, for improvements in cutting or carving wood, stone, and other materials. Sealed, August 27.

Jacob Brett, of Hanover-square, Middlesex, esq., for improvements in printing communications made by electric telegraphs. (Being a communication from abroad.) August 27.

Joseph Lambaux, chemist, of Paris, for improvements in atmospheric railways. September 8.

John and George Cox, of Gorgie Mills, Edinburgh, tanners and glue-makers, for improvements in tanning and leather dressing. September 8.

Hypolite Louis Francois Salembier, of Mincing-lane, London, merchant, for improvements in the manufacture and refining of sugar. (Being a communication from abroad.) September 8.

William Edward Newton, of Chancery-lane, Middlesex, civil engineer, for improvements in machinery or apparatus for spinning. (Being a communication from abroad.) September 8.

William Wylam, of Gateshead, Durham, esquire, for certain improvements in artificial fuel, and in machinery for manufacturing the same. September 16.

John Russell, of Edinburgh, accountant, for a manufacture of glass tiles. September 16.

Edwin Hill, of Bruce Castle, Middlesex, gentleman, and Warren De la Rue, of Bunhill row, Middlesex, manufacturer, for improvements in the manufacture of envelopes. September 19.

Jacob Brett, of Hanover-square, Middlesex, gentleman, for improvements in atmospheric propulsion, and in the manufacture of tubes for atmospheric railways, and other purposes. (Being a communication from abroad.) September 19.

James Hardcastle, of Firwood, Bolton-le-Moors, Lancaster, esquire, for certain improvements in the method of conveying water. September 22.

(Omitted in our former list.)

Thomas Russell, of Kirkaldy, Fife, iron-founder, and John Peter, junior, of Kirkland works, in the said county, for certain improvements in flax-spinning and flax-spinning machinery, which are also applicable to the manufacture of other fibrous substances. May 8.

James Lamb Hancock, Frederick Augustus Lamb Hancock, and William Lamb Hancock, of Guildsford, Montgomery, for an improved rotary steam-engine. May 13.

Erratum.—William and Colin Mather's patent was stated to be dated the 10th July; it should have been July 15.

NOTES AND NOTICES.

The American Steamer Marmora—The *New York Morning Herald*, in describing this vessel, which left that city, for Liverpool, at the beginning of this month, but has not yet arrived, says, "She is fitted with Ericsson's propellers, on nearly the same principle as the screws of the *Great Britain*, and carries a low-pressure engine, a new invention, by which the consumption of coal is comparatively small. The entire steam fixtures, boilers, engine, coal-bins, and all, do not cover a space of more than 16 square feet. A more compact and well-arranged engine has never been seen. The main and upper decks have a clear sweep, unencumbered by coal or steam machinery of any description. Her cabins are comfortable and airy, and fitted up with a great deal of taste and neatness, and are capable of accommodating 43 passengers. Her size is registered at 400 tons; she is 24½ feet beam, 10½ feet hold, and 145 feet keel; engine 155 horse power. She presents a very neat appearance; her rigging is that of a bark, lofty, and exceedingly well trimmed, and capable of carrying her ten knots with a fair wind. Her destination is Constantinople, whither she will proceed after making a stay of a few weeks at Liverpool, having been contracted for by the Turkish Government to ply between Constantinople and Paris."

The steam-machine for draining the lake of Haarlem was set to work the other day with complete success. In five successive hours it removed 300 cubic ells of water.—*Globe.*—For a full account of this engine see *Mech. Mag.* vol. xli., page 129.

New Anti-friction Metals.—*Galignani's Messenger* mentions the discovery of a new mixture of metals, called anti-friction, as a substitute for the use of brass in the various uses to which that metal has been hitherto applied in the manufacture of locomotive and other engines. From the statement of Messrs. Allcard, Buddicombe, and Co., who have made the locomotives for the Rouen and Paris, and other railroads, it appears that this metal, although very much lower in price than brass, and attended with an economy of 75 per cent. in the use of oil during the working, is of a duration so far beyond that of brass as to be almost incredible.

Italian "Division of Labour."—The high value of Italian farming produce is owing to the remarkable division of labour. It is rare to find the actual farmer, or manager of the ground, at the same time the cheese-maker. The "casaro" is justly esteemed an important personage; and, even where he forms part of a large establishment, is quite independent of the other farming servants. A great deal of the cheese is made in Lombardy by wandering "casari," who contract for the milk of a season, often from more than one dairy, and make the cheese in an out-house on their own account. Rice is extensively cultivated in Northern Italy. Instead of the flax of Belgium and Holland, the Italian produces another material for the loom, which is even of higher value. The dry lands that are not adapted to irrigation combine the culture of the mulberry-tree with that of the vine. The production of silk is again facilitated by a division of labour that is peculiar to Italy. The owner of the eggs, or, as they are termed, "the seed," appears at a farmer's residence, and contracts for his mulberry-leaves as the "casaro" does for his milk. He receives a shed, which is emptied for him, and remains six weeks—until his worms have attained their growth and spun. He then disappears with his crop of cocoons to seek the most skilful spinners, on whose work the value of what he has obtained very much depends. On the whole, it is scarcely possible to imagine a more pleasing instance of association, combined with division of labour in agriculture, than Northern Italy presents. The financial side of the picture is also a remarkable one. A comparison between the rents specified as paid in Northern Italy and the rents of England, or even of Scotland, will show how much more the Italian landlord receives than the English landlords, although the price of wheat is not higher than 33*s.* 8*d.* per quarter, and wine is only rated at 6*d.* per gallon.—*Banfield's Organization of Industry.*

The Water Lily.—On Saturday last, this rapid screw steamer left the Thames for the Dover station. She made the passage from Blackwall to Dover harbour in 7 hours 10 minutes, against a strong tide all the way, having started at low water. On Wednesday, she made her first trip across the Channel, from Dover to Boulogne, in 2 hours 23 minutes, and returned, on Thursday, with the *Magician*, in 2 hours and 10 minutes, beating that vessel by 1½ minute.

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1156.] SATURDAY, OCTOBER 4, 1845. [Price 3*d*.

Edited by J. C. Robertson, No. 166, Fleet-street.

HOWELL'S READING EASEL.

Fig. 1.

Fig. 4.

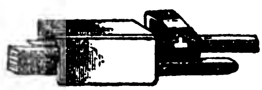


Fig. 2.

Fig. 3.

HOWELL'S READING EASEL.

[Registered under the Act for the Protection of Articles of Utility.]

A single glance at the prefixed engravings will suffice to satisfy any one that this is one of the most valuable presents which has been made for a long time past to the reading public. It is literally an instrument for *making reading easy;* for reducing it to an affair of the eyes alone, and leaving the hands, feet, in short every other part of the body, at perfect liberty. It forms an occasional appendage to a chair or sofa, which can be attached or detached at pleasure, with almost the same facility as a book can be taken up or thrown aside; and it supports the book while in use at whatever height and distance may suit best the optical powers of the reader.

The figures 1, 2, and 3 represent the easel as in actual use; fig. 4, the appearance it assumes when folded up to be laid (like the book) aside; fig. 5 is a side elevation, and fig. 6 a front elevation of the instrument by itself, and on a larger scale, than in the other figures.

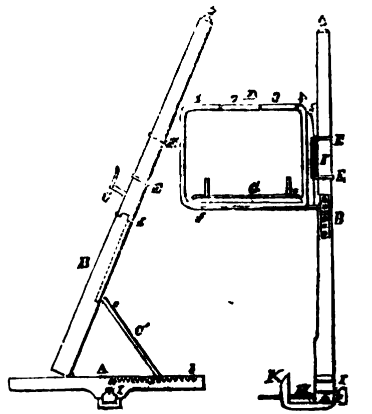
A is a horizontal foundation piece, which is slightly arched on the inside, and from *a* to *b* on the top surface cut with ratchet-shaped grooves in it, as indicated by the dotted lines.

B is an upright, consisting of two pieces connected together by a hinge at *d*, and attached at bottom by a strong hinge-joint to the horizontal foundation piece A.

C is a spur, which is hinged to the back of B, and when let down takes into the ratchet grooves on the top surface of A, so as to fix the upright B at any required angle of inclination. When the instrument is not in use, this spur is thrown back into a recess made for it between *c* and *d*.

D is a flap for holding the book or manuscript to be read. It consists of four separate pieces, 1, 2, 3, and 4, connected together at the back by a piece of cloth, or other flexible material connected thereto, so as to allow of the pieces being folded up together, when out of use; the outer piece, 4, is inserted edgewise into a stock, 5; and that stock is made fast to the upright B at any elevation desired, by means of the holdfasts E E. F is a spring inserted between two holdfasts, in order to keep the flap more firmly in the position assigned to it. G is a moveable ledge piece for the bottom of the book or manuscript to rest on; it turns on a pin, *e*, at one end, and when let down is kept fast in its place (as represented in fig. 2) by a catch, *f*.

Fig. 5. Fig. 6.



G is a screw clamp attached to the boss in the bottom of the foundation piece A, by means of which the instrument is secured to the side rail of the chair, or sofa, or other seat, of the person intending to make use of it. The clamp embraces the rail within the space H, and is screwed up tightly to it by the screw I.

MR. MALLET'S METHOD OF OBTAINING VACUUM FOR ATMOSPHERIC RAILWAYS BY DIRECT CONDENSATION OF STEAM—(CONCLUDED FROM P. 214.)

We are now enabled to determine the amount of vacuum that we shall obtain in the six miles of 15-inch tube by the use of the apparatus.

The capacity of the tube = 38872 cubic feet.

$$r = 38872 \text{ cubic feet.}$$

$$b = \frac{38872}{2} = 19436 \text{ cubic feet.}$$

Or assuming $r = 200$, and $b = 95$ as before, we have for the first stroke,

$$\frac{200}{95+200}\, d = 9{\cdot}687 \times 30 = 20{\cdot}34 \text{ inches of}$$

the rarefaction; and hence the vacuum at the first stroke,

$30-20{\cdot}34=9{\cdot}66$ inches of the vacuum-gauge.

For the second stroke,

$$\frac{200^2}{(95+200)^2}\,d=0{\cdot}458\times 30=13{\cdot}74 \text{ inches};$$

and hence the vacuum $=30-13{\cdot}74=16{\cdot}26$ inches of the gauge.

And thus for the four first strokes we have the following results, without correction for vapour or evolved air:—

1st stroke	9·66 inches	vacuum-gauge.	
2nd „	16·26	„	„
3rd „	20·64	„	„
4th „	23·61	„	„

Correcting for these we have the following nett amounts of vacuum, supposing no leakage by the long valve of the tube, and tube piston, which we have next to consider, viz.:

1st stroke	8·897 ins.	of vacuum-gauge.	
2nd „	15·460	„	„
3rd „	19·803	„	„
4th „	22·736	„	„

To which we have further to apply a correction for the leakage taking place by the long valve, &c., during the time of exhaustion.

Supposing both vacuum vessels empty, and the steam surcharged in the boilers, and in a condition to blow off, which would be the state of the apparatus after the passage of one train, and at the moment when a vacuum was required for the second, in such a state of things three strokes can be completed in the time that the air will rush from the tube into the vacuum vessels, added to the time required to fill one vessel with steam, condense it, and again equilibrate its amount of vacuum with the air of the tube.

We need not go beyond the third stroke, because it is plain that at it we shall have a vacuum sufficient to start the train.

It is therefore necessary to determine the time of blowing off the steam into the vacuum vessels; of the air from the tube rushing into them, and of the condensation of the vacuum vessels full of steam, which latter is only limited by the time in which the steam from the vacuum vessels can get into the condenser.

These times cannot be correctly calculated for want of experimental data. The usual formula give no approach to the results shown by experience. Judging, however, from experience in analogous cases, I estimate that—

The steam at 45 lbs. will fill the vacuum vessel in from thirty to forty seconds, expelling the air before it; the dimensions of the tubes being such as shown on the drawings.

The air of the tube will equilibrate with the vacuum vessel in from twenty to forty seconds. The time of condensation will be ten seconds.

Now, Barlow states that the vacuum-gauge fell at Wormholt Scrubbs at about the average rate of 4 inches per minute, when all was at rest, by leakage, the vacuum being from 21 to 12 inches of mercury.

Now in vessels of unlike capacity, but with the same amounts of leakage and vacuum, the fall of the gauge in the same time will be inversely as the capacities of the vessels leaked into; and as in the present case the railway tube will be constantly in communication with *one* vacuum vessel of half its own capacity, the average fall of the gauge per minute by leakage, on half a mile of 15-inch pipe, will be reduced in the proportion of the capacity of the 15-inch tube + the vacuum vessel, to the capacity of a 9-inch tube. We may, therefore, in round numbers, consider the leakage as equal to an average fall of the gauge of 1 inch of mercury per minute. The vessels, as stated, being already exhausted, the times of the first and second strokes will be forty seconds each, and the time of the third stroke will be about eighty seconds.

We have therefore at the first, second, and third strokes the following falls of the gauge due to leakage:—

1st stroke	0·66 inches	of mercury.	
2nd „	0·66	„	„
3rd „	1·33	„	„

And deducting these from the previous amounts of vacuum in the tube, as stated, we have the following for the nett amounts of vacuum:—

1st stroke	8·237 inches	of mercury.	
2nd „	14·800	„	„
3rd „	18·473	„	„

We have therefore at the third stroke a sufficient vacuum to start the train, and as good as that proposed to be obtained by the air-pump method. If the train start at this instant, we must continue to discharge the pipe as it advances of the air leaked into it, and remaining in it; and as the fall of the gauge may be taken at 1 inch per minute, it is obvious that

four strokes made at equal intervals during the transit of the train will more than meet this; or as the transit is made in twelve minutes, we must have one stroke made every three minutes, and for this the boilers are adequate.

We have thus then to complete the transit of one train over six miles of 15-inch pipe to make seven strokes. But we have already shown that each of these requires 12 cubic feet of water to be evaporated from 70° Fahrenheit into steam at 45 lbs. per square inch, and that each cubic foot so evaporated consumes 5·9 lbs. of coal. Hence, to pass one train over six miles, we must consume

$5{\cdot}9 \times 12 = 70{\cdot}8 \times 7 = 495{\cdot}6$ lbs. of coal; or say 500 lbs. of coal, including the power to feed the boiler and open valves.

We have further to determine the amount of power requisite for feeding the boilers with water, and for opening the valves, &c.

Four cubic feet of water is to be evaporated per minute at 45 lbs. per square inch = 3 atmospheres, which is equal to four cubic feet of water raised 3×34 feet = 102 feet + the lift of the suction pipe, say 10 feet more = 112 feet in all. This is $4 \times 62{\cdot}5 \times 112$ feet = 250 lbs. 112 feet per minute, or 28,000 lbs. 1 foot high per minute, or less than one horse power. The opening of the valves would probably, from their construction (double beat), not require one-half of this—but assume it as much, then two horse power will be more than enough = 20 lbs. of coal per hour, or about 3 lbs. of coals per train passed over six miles.

Let us now compare this with the consumption of coal requisite to pass one train over six miles of 15-inch pipe by the present air-pump system.

At thirty miles per hour the six miles is passed over in twelve minutes. The air-pump must make as many strokes as will clear the pipe of air during this time.

At Wormholt Scrubbs, capacity of pump = 14·4 cubic feet, and the ratio of the pump to the pipe 1 : 85. Capacity of six miles of 15-inch pipe $= 5280 \times 6 \times 1{\cdot}23 = 38966$ cubic feet.

Ratio of tube to pump 38966 : 14·4, or as 2710 : 1. Hence the pump must make 2710 strokes in twelve minutes $= \frac{2710}{12} =$ say 226 strokes per minute.

The pressure for 18 inches vacuum is 5·49 lbs. per square inch; 3·75 feet length of stroke $\times 226 = 846{\cdot}5$ feet per minute; area of pump = 1104 square inch.

$$\text{Hence, } \frac{1104 \times 5{\cdot}49 \times 846{\cdot}5}{33{\cdot}000} = 155{\cdot}5$$

horse power to discharge the pipe.

Assuming the piston and valve leakage the same nearly as for 9-inch pipe, and doubling *both* for the double length, (which will about compensate for errors in additional joint leakage,) we have the total power for six miles of 15-inch pipe as follows, viz.:—

Increasing now the pump space in the ratio of 25 : 217, and the vacuum space as half a mile of 9-inch pipe to six miles of 15-inch pipe, or as 1166 : 38966, or as 1 : 24·8, we have

	Cubic feet.
The capacity of pump	125
The capacity of vacuum space.	38966

or in the ratio of 312 : 1. The ratio of rarefaction is therefore $\frac{311}{312}$, and the number of strokes without leakage

$$N = \frac{\log.\ 30 - \log.(30-18)}{\log.\ 312 - \log.\ \ 311} = \frac{1{\cdot}477 - 1{\cdot}079}{2{\cdot}494 - 2{\cdot}492} = \frac{0{\cdot}398}{{\cdot}002} = 199 \text{ strokes,}$$

to which adding 50 per cent. for lost power, makes 298½, say 298, total number of strokes to obtain the vacuum.

$$\text{Then as } 58 : 298 :: 1'\ 30'' : \text{the time} = 463''\ 7'\ 7''.$$

Hence we have 217 horse power at work about eight minutes from starting to obtain the vacuum, and for twelve minutes to maintain the vacuum during the train's transit = in all twenty minutes, or one-third of an hour; and hence the amount of coal consumed to pass one train, at 12 lbs. per hour per horse power,

$$\frac{12 + 217}{3} = 868 \text{ lbs.,}$$

or at 10 lbs. per hour per horse power,

$$\frac{10 \times 217}{3} = 732 \text{ lbs.;}$$

the former measure is that which may be in practice calculated on, reducing therefore the above in the ratio of 52,000 : 33,000 for nominal horse power, we have the nominal horse power = 138, and the consumption of coal, at 12 lbs. per hour per horse power, required to pass one train = 552 lbs.

It is, therefore, established that an economy of fuel or of power results by my method over the present system, in the ratio of 500 : 552, taking the least favourable views respecting my method, and assuming a perfection in the air-pump which does not exist.

The largest losses sustained in this method of exhaustion are those due to leakage by the long valve. And if Mr. Bergin's results as to its amount are correct, reducing it in the ratio of 3 : 8, the saving in power or fuel by this method would be greatly more considerable than I have here estimated it.

It has been shown that the rapidity of producing the exhaustion in the tube, or of obtaining the vacuum, is dependent with a given proportion between the capacity of the vacuum vessels, and that of the tube, solely upon the velocity with which air can rush into a vacuum through a long orifice.

I am warranted, therefore, in concluding that the practical limit set by construction and outlay to the size of the vacuum vessels, is within a very large range indeed—the only limit set to the length of tube or distance between station and station. Six miles, therefore, seems by no means to be the utmost limit of this distance.

In comparing the rapidity of obtaining the vacuum in six miles of pipe by this method with that of the air-pump and 217 horse power, it will be observed that eighteen inches and upwards of vacuum is produced by this method in two minutes, whereas eighteen inches exactly is only obtained by the engine in seven minutes seven seconds. It seems, therefore, by no means vain to suppose that even three times this length, or *eighteen miles of pipe in one length, might be exhausted by this method.* The time of exit of the air at that length would not probably equal the time of exhausting six miles by the pump.

By combining this mode of producing the vacuum with my other proposal for storing or husbanding it, and also by the very nature of this apparatus itself, which, after the passage of a train, always will permit the steam of the boilers to be worked down in procuring and storing a vacuum equal to the capacity of both vacuum vessels, plus the condenser; and further, by the application of my proposed arrangements for withdrawing and smothering the fires of the boilers between the trains, I consider that nearly the whole power of the steam would be made available.

It is sufficiently obvious that this form of apparatus is at least as simple, and as little subject to derangement, as an engine and air-pump with boilers of equal power; I have, therefore, lastly to show how they stand comparatively as to outlay:

Estimate.

Apparatus for Direct Exhaustion.

220 tons of boiler work . . .	£5,575
Jacketing	600
Engine and valve gear, &c. . .	500
Boiler setting connections, foundations, and buildings over apparatus	1,000
Total . . .	7,675

Apparatus on Existing Plan.

217 horse-power engine and air-pump, at Samuda's estimate of 50*l.* per h. p. for both . .	10,850
Saving on each station, or every six miles in favour of direct exhaustion	£3,175

Without charging the existing system with any outlay for engine station buildings, the whole of which are included in the preceding estimate.

Description of the Engravings.

Fig. 1 (see No. 1154) is a sectional ground plan of the station buildings, &c.

Fig. 2 is a longitudinal section through A B of the station buildings, with side elevation of boilers, condenser, steam-engine, and valves, &c.

Fig. 5. Transverse section through C D, with end elevations of the vacuum vessels, condenser, &c.

a a, &c., are the six Cornish boilers; five are worked together.

b b, &c., the steam chests, on top of which are safety valves, as also duplicate safety valves at *c c*.

d d, the air tunnels, conveying draught to the fire-places, as shown in fig. 6, (No. 1155.)

e, the smoke tunnel, common to all the boilers, and conveying the smoke, &c., to the stalk *f*, beneath the boilers. This tunnel is so arranged that any one boiler can be worked irrespective of the others.

g g, the wheel work, or other gearing,

by which the fire-grates are moved in or out from under the boilers when the latter are in or out of use.

h h, &c., stop valves, by which the communication of any one boiler with the steam pipes *k k*, which are common to them all, may be cut off at pleasure.

i i, man lids to the boilers.

l l, the feed pipe for supplying the boilers with water from the feed pumps wrought by the small engine, 5. This engine is worked by steam from the great boilers; its office is to feed the boilers and open the valves *n o p*, by means of the cams, upon the cam shafts 6 6. 4 is the suction pipe of the feed pumps, which draws out of the hot well, 8, into which the condensed water from the condenser flows by the pipe 2; the overplus passing off by the drain 3 3.

m is a long tube of boiler plate of large diameter, placed in the smoke place or tunnel *e*, and which is always full of water; the feed pump discharging into it at one end, and the feed delivering into the boilers at the other, so that the feed water passes into them nearly boiling.

n, *o*, and *p*, are double-seated valves, moveable either by hand from the engine room below, or by the cams wrought by the engine, at pleasure. The offices of these valves are as follow:—when *n* and *o* are both open, and *p* shut, steam is free to enter the condenser, T, from the boilers; *n* being closed, and *o* continuing open, with the jets of water playing into the condenser, a vacuum more or less perfect is formed in either the right-hand vacuum vessel V′ V′, or in the left-hand one, V V; *n* and *o* being both closed, and *p* opened, the vacuum vessels are placed in alternate communication with the railway main *s*, by means of the pipes *r r*, and share their vacuum therewith.

w w, the water main and stop valve by which the jets of condensing water are admitted or cut off from the condenser T, during the whole time of one set of exhaustions of the vacuum vessels. These jets of water are kept constantly playing into the condenser. The condensing and condensed water are withdrawn from the condenser by means of the large syphon tube, 2 2, whose total height from the surface of the water in the hot well, 8, to the bottom of the condenser is at least 34 feet. The water, therefore, continues freely to flow off from the extremity into the drain 3 3, but no air can enter the condenser by the same pipe.

x x are similar syphon pipes, but of a much smaller size, to relieve the vacuum vessels of the small quantity of condensed steam which will be produced in them by the contact of the steam blown into them, with the wood lining of their sides.

All the vacuum vessels, as well as the condenser, are lined with wood and jacketed outside, in the way particularly shown in figs. 3 and 4, so as to reduce the condensation by contact of the vessels as much as possible, inasmuch as in the case of the vacuum vessels all cooling, and in that of the condenser all heating, will be attended with waste of steam.

y′ y′, *y y*, are the snifting valves of the two sets of vacuum vessels.

z z, the much smaller snifting valve of the condenser.

It appears to be immaterial at what level of the vacuum vessels the steam is blown in, provided it be blown very rapidly in, so as not only to *displace* the air and discharge it at the snifting valves, but to expand it and cause it to pass out by its increased bulk. From the very small difference in specific gravity that exists between steam at 212° and common air at 50° or 60° Fahr., and from the tendency to mutual diffusion, it is quite a mistake to suppose that in vessels of great capacity any distinct plane of separation can be preserved between steam and air. In comparatively small vessels a separation may be observed; but in large vessels, if the steam be blown in slowly enough to preserve such, mutual diffusion takes place; if rapidly, mixture; but if *very rapidly*, the air is driven out before the steam. This being the true principle of "blowing through," it is not important where the steam is admitted, provided the vacuum vessels are of a long tubular form, and that the passages for the egress of the air be at the ends remote from the steam entrance. I do not, however, confine myself to a horizontal position for the vacuum vessels, nor to any particular place for admitting steam. At first it occurred to me to have two very light disks or diaphragms, which without touching the sides of the vacuum vessels should, on the admission of steam, be driven before it, and parting from the centre aperture at *o*, right and left, pass to opposite ends

of the vacuum vessels, driving the air out before them, and on arriving there, be slowly brought back by a balance weight within the vessel; but this, after some consideration and experiment, seemed needless. Perhaps, ultimately, the best form of vacuum vessel, in every respect, would be a sphere; the steam to be blown directly in at the top, and the air blown out, by snifting valves arranged round the horizontal diameter and at the bottom. This would also give the greatest economy of material and space in their construction.

The water is assumed in figs. 1 and 2 to be supplied to the condenser by the pipe *w*, from an elevated head or source.

77. Is the shell of the station building, containing the exhausting apparatus.

99. The roof over same. These of course may be varied to any extent.

Fig. 3 is a longitudinal section of part of the condenser, at one extremity.

Fig. 4. partial transverse section of same.

a a, the interior of the condenser.

b b, the shell of the vessel, formed of boiler plate stiffened by *external* ribs riveted to an angle iron, *f f*.

c c, the wood non-conducting lining, formed of staves of yellow pine fitted in longitudinally, and of curved pieces fitted to the concave ends of the vessel.

d d, the external fir sheeting forming the outside of the jacketing. This surface of 1 inch fir surrounds the whole vessel at a distance of some inches, and is secured to the external ribs by square slips of wood screwed through these. The interspace between the sheeting and the plating of the vessel is filled in with dry sifted ashes mixed with sawdust, *e e*.

g, one of the blocks of stone upon which the condenser rests, being immediately sustained by the concave cocks, *n*, fitted to the lower side of it. As the inner lining is intended to prevent any sudden or considerable changes of temperature in the vessel, and as it is also jacketed outside, there is no necessity in this case for providing against expansion and contraction in the structure of the supports, as in fig. 1.

k, the communication pipe with one of the vacuum vessels, *v' v'*, or *v v*.

l, the main supplying the water for condensation, capable of regulation or of being shut off by the valve, *m*.

n, is the pipe of distribution, pierced full of holes along the upper part of its surface, and running the whole length of the condenser; so that jets of water play up into the body of the condenser at all points.

o, the snifting valve, the upper side of which is kept immersed to a small depth in water, so that the progress of blowing through may be told by the cracking noise usually known to be produced by the passage of steam through cold water. The water is fed into the snifting valve troughs by a small pipe.

The construction of each cylinder of the vacuum vessels is precisely similar to that of the condenser, with the exception of the supply of water. The lining and jacketing are the same. The snifting valves are larger, but immersed in water, and balanced in the same way, so as to be capable of being opened by the feeblest possible pressure from within.

Fig. 6 is a longitudinal section of a portion of one of the steam boilers, showing the details of construction of the fire apparatus, &c.

a a, the cavity of the boiler, steam and water spaces. The boiler is of the Cornish form, *i. e.*, one cylinder eccentrically within another; the fire being in the inner one, which, beyond the bridge, forms the first flue, and in the centre of which, and therefore surrounded with flame, is placed the tube *a'*, wholly filled with water. The flame and gases, &c., of the fire pass off over the bridge, from the fire-places at *both ends* of the large boilers here designed. Towards the centre of the length of the boiler, a brick wall of separation is built across the internal flue, at either side of which the draught from the fire at one end or the other, passes down through an aperture in the bottom of the internal flue, or through the water space; thence it returns under the bottom of the boiler, towards the two ends, from *v* to *w*, and at *w* the flue splits, and one-half the draught passes at either side of the boiler back again to the centre, and so into the tunnel or horizontal flue, (*e*, figs. 1 and 2,) and into the stalk. This arrangement gives an immense fire and flue surface, with that sort of draught that answers best in Cornish boilers, and economizes fuel so completely.

b b is the fire-grate (the same at each

end of each boiler). The grate rests upon a complete frame of cast-iron, carrying with it the fire-door, *i*, and lined all round inside, or next the fuel, with fire-brick. This frame is made to traverse on the rollers, *c c c*, either from *c* to *p*, or *vice versâ*, by means of the wheels and pinion, *r d*, in dotted lines, outside the setting, and connected with the toothed pinion and roller, *c'*, taking into a rack attached to the frame, 66.

f is the ash-pit under the grate, formed to be cleared by the rake, *g*, which draws the ashes down into the ash-tunnel, *n*, whence they are removed without interfering with the draught.

m is the cold-air tunnel to supply draught to the fire, through the grated ventilator, *n n*, which is made to open or close by the lever and balance weight, *p o*. *y z*, the directing plate for the entering current of air.

e is the bridge; *t t*, the internal flue; *v*, the lower flue under boiler bottom; *w*, the entrance therefrom to the side flue.

The boiler is at work in the position of the fire-grate, &c., shown in the figure, and the air to supply it passes up through the ventilator, *n n*, and taking the general directions shown by the arrows, passes under the grate, 66, and through the fire, &c.

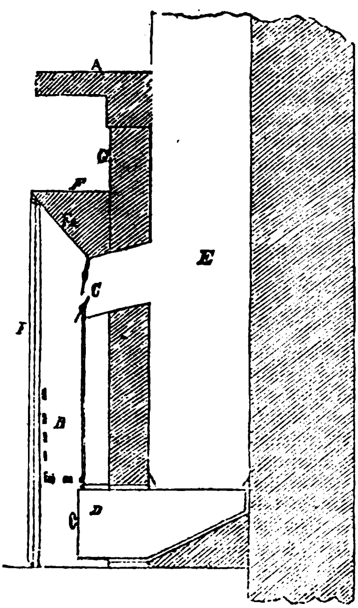
When the boiler is not required to generate further steam for a time, the fire and fire-grate are withdrawn or moved back from under it by the wheels, *r d*, &c., and run back under the fire-brick arch A, until the internal fire-door, *i*, comes in contact with the frame of the outer one, *k*. Fresh fuel is now thrown on, and all the doors, *i k*, and the outer air-doors, *l*, closed home.

In the act of running back, the fire-grate, 6 6, the stop, *q*, strikes the lever, *p p*, and shuts off the supply of air to the fire through *n n*. The fire can now no longer burn freely, but the heat radiated from its upper surface, in place of being expended in generating steam immediately in the boiler, is now absorbed by the brickwork of the arch, A, which becomes red-hot.

If things were preserved long enough in this state, the fire would go wholly out, but as these boilers are required at intervals of from half an hour to an hour or so, this does not occur. Steam is now again required; for this purpose the fire-grate is again run forward under the boiler, as shown in fig. 6; in doing so, the air is re-admitted through *n n*; and by the directing plate, *y z*, the currents are caused to sweep under the surface of the heated arch, A, and side-walls of the chamber, *d k*, the whole of the heat of which is thus carried away and swept through the flues of the boiler. Thus, by this arrangement, the heat of the fire that would be otherwise lost between the times of trains is husbanded by being absorbed by the brickwork as in a magazine, and is at once when wanted given back and made use of. It is obvious that this construction of boiler is applicable to every operation requiring the intermittent use of large volumes of steam, as well as to the existent mode of exhaustion upon atmospheric railways. The fire-place should be so proportioned that the fuel shall need no poking or raking, and no supply except at the intervals when drawn back under the arch, A, when the bars may be cleaned; a large deep body of fuel, slowly but perfectly burnt by a sufficient supply of air, will be found always to give a more economical result than what is called "thin firing" with continual stoking.

The top of the boilers are covered to the depth of some inches with sifted ashes, *s s*, as jacketing.

At the end of Mr. Mallet's Memoirs there are four Supplementary Articles, illustrated by plates—the *first* containing an account of a mode of obtaining vacuum by a combination of the method of direct condensation of steam with that of the displacement of air by water; the *second*, "a design as originally made for water-vacuum vessels, or apparatus for obtaining vacuum for atmospheric railways by the employing of vessels of water by tubes of more than 34 feet in height—on the Toricellian Principle;" the *third*, "the details of a new long valve and main for atmospheric railways," and the *fourth*, "details of an arrangement for releasing the head of the travelling piston instantaneously, in case of accident in the line or to the train." The last two appear to us eminently deserving attention, and we shall hereafter also give them at length.—ED. M. M.



Having spun a yarn upon stoves, now comes another upon grates. After examining and experimenting upon most kinds which have been invented, the conclusion I have come to is, that the best for general use is that called the Kennard, but which might more properly have been termed the Rumford, and it could be shown to have been used by the late Sir John Robison even previously. The merits of this grate are economy, a good draft, with great heating power, owing to the use of fire-brick. Its compact neat form, or the more polished bright appearance which can be given with a great degree of elegance, should also be added as recommendations. As long as the public are satisfied with paying a larger price for a less efficient article, the manufacturers cannot reasonably be expected to press into notice a less costly one. Such is the case with this grate. But a man can fit up his principal rooms with costly grates on this principle, for the fire-brick is the main thing, while the rest of the house should have the really *useful*. The grate I refer to does not require a minute description, it is coming into such general use. It has a bevelled metal front contracting the fire-place to a smaller space, while the sides and back are lined with fire-bricks about 3 inches thick, and made in three parts. These grates should be less bevelled in and kept more to the front; the front of the fire should be even without the perpendicular line of the inside of the chimney (I speak of Scotch 3 feet walls); the width from the front bars to the back brick should be less, never exceeding 8 inches, while the length of the fire-bars should be extended if more heat is required. With these precautions, I found rooms which were intolerably cold, with huge fires in other grates, made as warm as possibly could be wished with much less coal. Mr. Steele, of Edinburgh has introduced an excellent plan for a lid which totally excludes back smoke or soot when a fire is not required; this should be used in all these grates. To be used most economically, these grates should, after blazing well up, so as to heat the room, be covered with dross, and so left till the evening circle draw round, when one blow causes a blaze.

There are many much more showy grates which may have some little advantage in one particular point, but divested of this pretension, are not equal to the kind mentioned, while there is no comparison in point of cost. In the one, nothing can be obtained under two figures, whereas in the other it requires some ingenuity of design to raise the price above one figure. I have seen statements by able men about some grates being good ventilators; but they have mistaken attempts at circulation of heated air for ventilation. The fact is, all grates are bad ventilators, as the best are low; while the air is generally admitted low also, and makes its most direct way to the fire, without kindly making a circuit of the room. Ventilation must be otherwise arranged, and requires, together with lighting, and the supply of water in private houses, to be brought more into practical notice. Mr. Sylvester, as also Mr. Steele, have done much for all sorts of grates. I refer particularly to the kitchen range of the latter, with which I am best acquainted. I by no means wish to derogate from that of Sylvester; but Mr. Steele's can hardly be surpassed. Sylvester has thrown out plans for still further im-

provements in fire-places, especially that of carrying the vent down, as well as up. This should be done in all new houses, in the principal rooms. Another improvement of his is the folding bars for regulating the draft. I have to conclude by suggesting the modification of his plan represented in the prefixed engraving.

Description.

A is the chimney-piece.

B, the fire-place, sides and back of fire-brick.

C, the smoke vent, with iron shutters.

D, a drawer, which can be pulled out, and into which the soot falls.

E, the chimney, which is built up to a proper size, and is bevelled off to allow the soot to fall into D.

F F F, iron, polished or not; F^2, polished to reflect fire.

G, shape round fire-place, covered with tile, or ornamental iron work.

The advantages would be, full benefit of the heat, power of regulating the fire and sweeping the chimney without annoyance. The whole might, as suggested, be highly ornamented, or plain and neat.

FORESTER.

ON THE METHOD OF COMPUTING THE TIME AT ANY PARTICULAR PLACE, AND ALSO THE DIRECT DISTANCE BETWEEN ANY TWO PLACES WHOSE LATITUDES AND LONGITUDES ARE KNOWN.

Sir,—At page 370, vol. xlii., there is given an abstract of a paper by Benjamin Lewis Vulliamy, Esq., on the Construction and Regulation of Railway Station Clocks. This paper was read at a meeting of the Institution of Civil Engineers; and, in consequence of the great importance attached to the subject, it led to a very animated and interesting discussion among the members of that body who happened to be present at the time the paper was read. The same paper, moreover, suggested another, page 410, of the same volume, continued at page 417, on the method of computing the time at any particular place, by means of data derived from observations of the sun or a fixed star; this was likewise followed by a second paper of a similar character, page 4, vol. xliii., for calculating the direct distance between any two places on the surface of the earth of which the latitudes and longitudes are known.

These two papers were drawn up with the best of motives, and with the utmost degree of unassuming modesty and candour, holding out no pretensions of any kind, and claiming only the very humble merit of endeavouring to direct the attention of your readers to the solution of two important problems in spherical trigonometry; but certainly without the writer thereof entertaining the most remote idea that they would either require remarks, or be deemed sufficiently meritorious to deserve them. They have, notwithstanding, been animadverted upon by one of your correspondents, who has frequently figured as a critic, or rather hyper-critic, in your pages. In the present instance, however, the wrangler has thrown down the gauntlet in vain; for no one feels disposed to take it up; and your humble servant, the writer of the condemned papers, although he has long enjoyed a considerable share of notoriety in the list of contemporary authors, has never yet condescended to notice criticisms on any of his numerous works, whether favourable or the reverse, well knowing that those who arrogate to themselves the office of judges or censors in cases of this nature, are not at all times the best qualified for the purpose. It will, therefore, be seen, that there is no intention on the part of the writer to enter the arena of disputation, for neither his means nor his inclination will admit of it; and he feels disposed to accord to "KINCLAVEN" the *justness* of his remarks, as far as they are just. His sole object, therefore, in taking up the pen on this occasion is, to examine the several circumstances of the case; and, by making a fair and impartial comparison of the results, to let them stand or fall according to their deserts.

Recurring to page 410, vol. xlii., and attentively examining the premises there laid down, it will at once appear for what purpose the subject was undertaken, and for what reason the method there employed was adopted; but, in order to avoid the trouble of reference, it will be proper to repeat the passage that bears directly on the point. It is as under:—

"The method of resolving this problem by reference to the circles of the sphere, is the true and legitimate method by which the solution ought to be performed; this, however, presupposes a knowledge of the projection of the different circles that can be drawn on the surface of the sphere; and this is the very point which constitutes the difficulty and mystery of the subject. In order, therefore, *to avoid this difficulty, and to render the steps of investigation as plain as possible, we shall adopt the principle of development, as by this means the calculation requires nothing beyond the rules of plane trigonometry.*"

Here, then, the method to be employed, and the reasons for adopting it are distinctly stated; on this point, therefore, there is no room for criticism. But it is not insinuated that the method here employed is superior, or even equal to other methods; on the contrary, it is acknowledged at the conclusion of the paper, page 421, that the same thing can be done more expeditiously in numerous other ways, by the aid of subsidiary tables; but these, and all other methods involving radical expressions, it was the writer's determined object to avoid, and to confine himself solely to the method of development, and the formulæ arising from it.

After describing the process of development, and showing how to reconstruct the *trehedral solid*, an operation which, from the nature of the subject, is rather lengthy, but not more so than is necessary under the circumstances, the investigation is proceeded with, and the following equation is ultimately arrived at: viz.,—

$$\cos. B^* = \cos. b \operatorname{cosec.} a \operatorname{cosec.} c \mp \cot. b \cot. c.$$

This equation is general for determining one of the angles of an oblique-angled spherical triangle, when the three sides are given; and the corresponding symmetrical equations for the other angles are easily deduced from it, by simply observing the order of arrangement. They are as below: viz.,—

$$\cos. A = \cos. a \operatorname{cosec.} b \operatorname{cosec.} c \mp \cot. b \cot. c.$$
$$\cos. C = \cos. c \operatorname{cosec.} a \operatorname{cosec.} b \mp \cot. a \cot, b.$$

Now all this, it is manifest, could easily have been done at the time of investigation; and the development might have been so modified as to represent the three angles expanded on a plane, from which expansion the formulæ exhibited above could readily have been deduced: this, however, was foreign to the writer's purpose, and it would also have been inconsistent with the conditions of the problem, which requires nothing beyond the determination of the horary angle, or the angle at the pole, contained between the meridian of the place, and a declination circle passing through the centre of the sun, or a fixed star.

Each of the above equations consists of two terms on the right-hand side, connected by the signs *minus* and *plus*, the one term containing three factors, or members, and the other containing two. In this form, the theorems are wholly free from surd expressions; but they are not well adapted for logarithmic computation, since it is necessary to compute the terms separately. They are, however, very convenient for assisting the memory, as there are only the three trigonometrical functions, *cosine*, *cosecant*, and *cotangent*, to be remembered, and nothing can be more elegant and concise than the forms which they assume, admitting of a numerical arrangement, exceedingly neat and easy of performance. It is true there are three different tables required in the process when it is performed as far as it can be by logarithms; but since these tables are generally placed in juxta-position, it is not easy to conceive how any difficulty can arise from this circumstance, more than by referring to different places of the same table. If, however, we choose to dispense with the use of logarithms, and calculate by the rules of common arithmetic, one table will be found sufficient for the purpose; and it will be shown a little farther on, that the extra labour required in this case is not very considerable.

With respect to the signs under which the above equations are represented, no ambiguity can possibly arise in the application of them, especially to those who are acquainted with the elementary principles of the science, and it is not expected that those who are not, will attempt a calculation under any circumstances; it may however be useful to attend to the following observations, in order to know when such and such a sign must be employed.

Now, it is manifest, that the first term, which consists of three members, will be positive or negative according as that member in it, which is expressed by a cosine is less or greater than 90 degrees, or a right angle; that is, positive when less than 90 degrees, and negative when greater, the other two members being expressed in terms of the cosecant are always positive, and consequently, have no influence in changing the common sign.

Again, in the second term of the equations, or that which consists of two members in terms of the cotangents, the sign will obviously be positive when one of the members is less than 90 degrees and the other greater, and it will be negative when both members are less and both greater than the same standard quantity of 90 degrees.

These are the conditions to be considered, when the equations are employed in a general way, to determine an angle from the three given sides; but as this was not the

* The capital letter H is employed in the original paper, as being the initial letter of the word *hour*, or *horary*; but we here employ the capital letter B to denote the angle opposite to the side *b*, as being more consistent with the notation conventionally used in the science.

object of the original paper, it would have been foreign to the writer's purpose to have noticed them at the time it was drawn up. The design of the paper was, to give a distinct and independent method of calculating the time at any particular place, by means of data derived from observations of the sun or a fixed star, and this method it was intended should be deduced from the expansion or development of the *trehedral solid*, a method of construction which, in consequence of its simplicity, cannot be too familiarly known.

The formula arising from this development, when adapted to the purpose for which it was originally intended, is as follows, viz.:

$$\cos. \textit{hor. ang.} = \sin. \textit{alt.} \sec. \textit{lat.} \sec. \textit{dec.} = \tan. \textit{lat.} \tan. \textit{dec.}$$

In this expression the *minus* or *plus* sign must be employed, according as the latitude of the place and the sun's declination are of the same or of different names; that is, both north or both south, or the one north and the other south; the formula requires no other circumstance to be considered, and this distinction can occasion no difficulty.

At page 135, vol. xliii., your critical correspondent, "KINCLAVEN," has given another formula for finding the time, as being better adapted for logarithmic computation; it is as follows, viz.:

$$\cos. \tfrac{1}{2}\, \textit{hor. ang.} = \sqrt{\sin. s \sin. (s-a) \sec. \textit{lat.} \sec. \textit{dec.}}$$

where the symbol s denotes the half sum of the three sides of the triangle, formed by the complements of the data, and a the complement of the altitude, or the side opposite the angle sought. It is here stated with some show of self-gratulation, that this equation is *not only* well adapted to logarithmic practice, but that it requires *only* five steps, and moreover, that it supersedes the *distinction* of cases incident to that which precedes it. Now, if this be so, in what manner is the quantity c in the expression $\frac{a+b+c}{2}$ determined, when the latitude of the place and the sun's declination are of the same and of different names? Is it not by a subtraction in the one case, and an addition in the other? Certainly it is, for be it remembered that a, b and c in the theorem are not the quantities given in the question, but the complements of those quantities, and this being admitted, the superiority of the one form over the other in respect of cases falls to the ground, for the distinction of cases cannot be avoided by any means, as long as the latitude of the place and the sun's declination are referred to the equator and equinoctial, or as long as the sciences of geography and astronomy remain. It is true that there can be no ambiguity in the result derived from the second of the above theorems, for half the angle subtended by the zenith distance must always be less than a right angle; but it is equally true, that there can be no ambiguity in the result derived from the first theorem, for since the answer comes out in terms of a cosine, the positive or negative affection is perfectly sufficient for determining to which angle that cosine belongs; at all events, the uncertainty to an *unscientific calculator*, is not greater in the one case than it is in the other; for if the angle, as calculated by the *condemned* theorem, may be either 77° 3′ 44″, or 102° 56′ 16; why may not that derived from the *improved* theorem, be either 51° 28′ 8″, or 128° 3′ 44″, seeing that the result of calculation is a cosine by both methods; doubling these quantities, we get 102° 56′ 16″, or 256° 7′ 28″; so that it appears, an *unscientific calculator* is more likely to be led into error by the critic's *well-known* equation, than by the one which it is intended to displace.

It now remains to draw a comparison between the antagonist equations in point of facility of application; and for this purpose, it will be convenient to take the data of the example at page 135 above referred to, in which no seconds occur, and consequently no subsidiary calculation is required on that account. The data are as follows: Latitude 51° 32′ north; altitude of the sun's centre 10° 30′, and the sun's declination 23° 20′ north; and the process by the rule deduced from the development of the solid, is thus performed.

Altitude	10° 30′	log. sin.	9·260633		
Latitude	51° 32′ north	log. sec.	0·206168	.... log. tan.	0·099914
Declination	23° 20′ north	log. sec.	0·037055	.... log. tan.	9·634838
	0·31905..	log.	9·503856	−0·54294 log.	9·734752
				0·31905 subtract	
				−0·22389 = natural cosine of the	

required angle. Now, if the natural cosines had been given in the table up to 180 degrees, this result would have led us to 102° 56′ 16″ and not to 77° 3′ 44″, for the

cosines of all angles above 90° would in such a case be marked with the negative sign; it is therefore manifest, that the liability to be led into error arises from the limited nature of the tables, and not from any deficiency in the method by which the result is obtained; there can be no ambiguity in cases where the answer is brought out in terms of a cosine. The tabular angle corresponding to the above cosine considered positively, is 77° 3′ 44″; but since the cosine is actually negative by the nature of the formula, the angle to which it belongs is greater than a right angle, and equal to the supplement of that which the tables supply; the required angle is therefore 180°—77° 3′ 44″=102° 56′ 16″.

Here then it is evident, that the above process down to the determination of the natural cosine of the angle, requires five openings of the book, viz., three in the table of logarithmic sines, tangents and secants, and two in the table of the logarithms of numbers; there is also a sixth opening required to find the angle corresponding to the calculated cosine, and this is in the table of natural cosines; in all, six openings of the book.

Now, it is certainly of very little consequence, whether these six openings are all made in one or in three different tables, provided they are placed together so as to occasion no difficulty or loss of time in referring to them. But besides these six openings of the book, there are two additions and two subtractions, viz., one subtraction in the natural numbers, and one in the angular magnitudes, making in the whole process, not more than ten distinct steps, one of which is not required when the angle is acute.

In the foregoing process there is no preparatory work required, the calculation proceeding immediately with the given quantities; not so, however, with the other equation, the operation by it being as below.

Preparatory	Step 1......	$a=90° - 10° 30' = 79° 30'$			
	Step 2......	$b=90° - 51° 32' = 38° 28'$	log. cosec.	0·206168	Step 7.
	Step 3......	$c=90° - 23° 20' = 66° 40'$	log. cosec.	0·037055	Step 8.
	Step 4.................	$a+b+c=184° 38'$			
	Step 5.............	$s=\frac{a+b+c}{2}=92° 19'$	log. sin.	9·999645	Step 9.
	Step 6....................	$s-a=12° 49'$	log. sin.	9·346024	Step 10.
				2)19·588892	Step 11.
	Step 13.............	$\frac{1}{2}$ *hor. ang.*$=\frac{51° 28' 8''}{2}$	log. cos.	9·794446	Step 12.
	Step 14...........	*hor. ang.*$=102° 56' 16''$			

Now, the above are faithful statements and representations of the facts; from which it appears, that instead of the first equation requiring *no less* than eight steps, and the second *only* five, as stated by your correspondent; the first requires *only* ten steps, and the second *no less* than fourteen, five of which are openings of the book, being one opening less than is required by the first method, and the number of figures is nearly the same in both cases. It was all very well to keep the necessary preparatory work out of view, in order that the remaining part of it might suit his own purpose, by giving an apparent advantage to the method which he employed; but when the whole work is exhibited by both methods, it will be no difficult matter for your readers to decide on which hand the advantage lies.

We have now to show, that by dispensing with the use of logarithms, and calculating by the common rules of arithmetic, the result can be obtained from the first equation, by reference to one table only, and requiring only four openings of the book. The process is as exhibited at the close of the article.

Now, there is nothing formidable in the process as thus performed, and the extra labour required is not very considerable; but this method is very seldom if ever resorted to in the present state of the science; indeed, it was for the very purpose of avoiding such operations that logarithms were invented at all; the process has only been performed in this place, pursuant to a previous notice, to show that the solution can be made out by means of the equation that has been so much censured, and by reference to one table only.

With regard to the second problem, page 4, vol. xliii., it is only necessary to remark that in this the critic has, as in the first case, entirely mistaken the writer's motive; for he says,

"After a very long geometrical investigation, he ultimately, at the final equation, cos b=cos B, sin a, sin c+cos a, cos c. Now this takes up nearly three columns;

but the proof might be made out in two or three lines from his first equation."

Granted.—The investigation is long, though not more so than necessary to explain all the circumstances, and the proof might be made out in the manner stated; but had "KINCLAVEN" read the preamble to the problem, he would probably have discovered that it was not the intention of the writer to deduce the rule, or the proof of the rule in this way; for it is expressly stated in a passage of the second paragraph, that he had been "*induced to propose it in an insulated form, independent of all other problems of a kindred nature*," &c.

With regard to the number of cases into which the problem divides itself, they cannot be got over by any means, whatever may be the form of the equation by which the problem is resolved, since they refer to the data of the question under different conditions, and not to the results obtained by this or by that equation. Your correspondent will therefore see that on the whole the objections that he has raised are not so valid as he seems to consider them; and if he had rightly consulted and understood the writer's motives, and the circumstances that prompted his choice in the method of solution, he would probably have been induced to reserve his censures for another purpose.

The two equations advanced, pages 135 and 150, vol. xliii., on the supposition that they are new, are not so; the demonstration of the first is self-evident, and that of the second is not difficult; they, or properties similar to them, are as old as the time of Hipparchus, but they probably never were represented in the exact form which they now assume, until Leonard Euler established the algorithm which has raised trigonometry to such a distinguished place among the sciences. I shall now take leave of your correspondent by informing him that the object of the second problem is not the determination of the *time*, but the *distance* between two places; see page 151, where it is stated that 100° 46′ 18″ is the time as before nearly. The inconsistencies that display themselves in the calculation immediately preceding this announcement must be attributed to the printer. A. B.

Arithmetical Process.

Latitude	51° 32′	nat. sec.	1·60756		nat. tan. 1·25867	
Declination	23° 20′	nat. sec.	6·09801	inverted,	nat. tan. 63134	inverted,
			160756		50347	
			12860		3776	
			1446		126	
			10		38	
					7	
			1·75072			
Altitude	10° 30′	nat. sin.	42281	inverted,	—·54294	
					·31905	subtract,
			17507			
			14006		—·22389,	nat. cos. as before.
			350			
			35			
			7			
			·31905			

CYLINDRIC AND CONIC SECTIONS.

Sir,—I have explained the general character of one projection of the line of intersection of a cylinder and a cone, at page 143, vol. xliii.

Another projection of the same line of intersection, if made on a plane perpendicular to the axis of the cylinder, will be the arc of a circle, of the radius of the cylinder, and which, in that example, can never exceed a semicircle.

A *third* projection of the same line of intersection, if made upon a plane parallel to the axis of the cylinder, but perpendicular to the plane on which the first projection of the line of intersection was made, will give the projection of both branches on one line. That line, thus projected, will resemble one branch of a cuspidated conchoid. The line formed by the first projection, as has been explained, resembles the reciprocal of the conchoid, with both its branches.

But, it may be again observed, the *third* projection gives only *one* branch of a line resembling a cuspidated conchoid. It may, however, be imagined that the plane of projection may divide, and thus complete the two branches of the resemblance of the cuspidated conchoid.

This is as easy to conceive as it is to explain. Now, by the simple motion of the common trammel, the form of every possible elliptic section that can be made by planes cutting a cone at every possible angle in every possible direction, can all be produced at once on one plane.

Altering the angle of direction, and altering the distance of the tracer, appear to be equivalent to altering the angle and position of the plane elliptic section.

I am, Sir,
Your obedient servant,
J. JOPLING.

29, Wimpole-street, September 29, 1845.

CAPTAIN ERICSSON'S SCREW PROPELLER.

Emerson v. Hogg and Delamar.

Circuit Court of the United States, 1845.

This was an action for an alleged infringement of a patent granted to the plaintiff for a submerged wheel, with spiral paddles, intended to propel vessels. The defendants conduct the Phœnix Foundry, in the city of New York, and had fitted various vessels with "Ericsson's propellers." The principal question in the cause was, whether these propellers, claimed to have been patented by Mr. Ericsson, were substantially the same as the wheel patented by the plaintiff.

The plaintiff, Mr. John B. Emerson, produced and read to the jury a copy of his letters patent, dated 8th March, 1834. He proved, by Dr. Jones, that, at the time of filing his specification, he deposited in the Patent-office a drawing of the wheel, and also a model. The original specification, drawing, and model, were destroyed by a fire which consumed the Patent-office in December, 1836.

The counsel for the plaintiff then produced and offered to read a certified copy of a drawing made by the plaintiff, and filed in the Patent-office on the 28th February, 1844; this was objected to by the defendants' counsel, on the ground that the specification did not refer to any drawing, and that none had been annexed thereto—this objection was overruled, and the drawing was put in evidence.

The deposition of Dr. Jones, of Washington, was then read, by which it appeared that the plaintiff came to that city in March, 1844, and had with him the model of his improved wheel; that Dr. Jones was consulted by him, and then advised him that the drawing filed in February was imperfect, and an inaccurate delineation of the wheel, and that thereupon Dr. Jones prepared a new drawing, with references, which was sworn to by Emerson, and filed on the 27th March, 1844. The counsel for the plaintiff then offered to put this corrected drawing in evidence. The counsel for the defendants objected, upon the ground that the Commissioner of Patents had no right to receive and file more than one drawing, and that by the filing of the drawing made by Emerson in February, the power conferred by the Act of 1837 had been exhausted. The Court overruled the objection, and the second drawing was put in evidence.

The counsel for the plaintiff then produced the model of a ship, with the propeller wheel, patented by the plaintiff, and then read the deposition of Charles Robinson, who deposed that he had made the said model in the year 1837, in New Orleans, and that it had been publicly exhibited for a year, in the Merchants Exchange of that city, and from thence was taken to the plaintiff's ship-yard.

The plaintiff's counsel then called William Serrell, who testified that he was a civil and mechanical engineer. Being shown models of the plaintiff's wheel, and of Ericsson's propeller, he stated that he had examined them, and had been forced into the conclusion that they were essentially the same.

This witness was subjected to a very long and minute cross-examination, which strongly exhibited his accurate and scientific acquaintance with the principles of practical mechanics. He stated, in substance, that the two machines were substantially the same in mechanical construction and action; that he could construct the plaintiff's wheel from his specifications. He went into a detailed explanation of the specification, and said, that, taking it as a whole, he considered it sufficiently disclosed that which the inventor intended to construct.

The plaintiff's counsel also called James P. Allaire, who testified that he had been engaged for many year in making steam engines and other machinery; that "Ericsson's propeller" was indentical in mechanical construction and effects with the plaintiff's wheel. He examined the specification, and testified that he could from it construct a wheel similar to the models produced in Court.

John C. Kiersted testified that he was a practical mechanic, and that, taking the specification, with either of the drawings filed by Emerson, he could construct a wheel similar to the models. He also proved that the defendants had made and applied "Ericsson's propellers" to a large number of vessels.

Stephen E. Glover testified that he was acquainted with "Ericsson's propeller;" that he had been interested in his patent, and that the charge for the use of his propeller was three dollars per ton for large

vessels, and two dollars and fifty cents per ton for those of a smaller class.

The counsel for the defendants admitted that they had applied "Ericsson's propellers" to six vessels, each of 150 tons, and to one vessel of 340 tons.

The counsel for the defendants then called Dr. Dionysius Lardner, who testified that, before the date of the plaintiff's patent, he had seen propellers in England which had been patented by Mr. Perkins, and also by Mr. Smith. Models of them were produced, but the witness admitted that they differed substantially from the plaintiff's. He testified that the specification was vague and indefinite, and that he could not, from its directions, construct a wheel such as the plaintiff claims to have patented.

The deposition of Charles M. Keller was then read. He testified that he was a clerk in the Patent-office; that he had officially examined the two patents of Emerson and Ericsson; that, in his opinion, they were different, and did not conflict; and that he had made a report to that effect to the Secretary of the Treasury.

James J. Mapes, and William A. Cox testified that they were consulting engineers, and that they had read the plaintiff's specification; that it was vague and indifinite, and that they could not, from its directions, construct the wheel claimed by the plaintiff. Upon cross-examination, these witnesses stated that they were not practical mechanics.

Joseph Belknap, a draughtsman in the employ of Dunham and Co.; James Cochran, second engineer of the steamer Princeton; and George Birkbeck, jun., a person in the employ of the defendants, stated that they could not, from the specification alone, have constructed the wheel; but that, with the aid of the corrected drawing made by Dr. Jones, they could have done so.

The Court charged the jury, that the patentee is bound to file a specification of his discovery, which shall apprise the public of his invention without ambiguity or uncertainty; that if they shall find that the plaintiff originally filed drawings, so that all persons might have examined them, and that such drawings were similar to those produced in the trial, then they might come in aid of the specification. He directed the jury to view it as the whole specification, and gather from it what the plaintiff intended to claim. His Honour then examined the terms of the specification in detail, and reviewed the testimony of the witnesses. He instructed the jury, that they must construe the language as addressed to men skilled in this branch of art—and if a competent mechanic could, from it, have constructed the wheel, it is sufficient. If such a mechanic could not, from the specification, have constructed the machine, then the plaintiff must fail, unless he can help it out by the drawings; but these must be shown to have been filed with his original application; that in this case, the Patent-office and its contents having been destroyed by fire, he is compelled to supply the evidence the best way he can. The Judge then reviewed the evidence as to the drawing filed in 1844. He further instructed the jury that it had been contended that Emerson had abandoned his patent to the public by non-use; that this might arise either from positive abandonment, or might be implied from circumstances—and if the jury should find that he had relinquished his right, then he could not maintain this action; that a patentee cannot lie by an unreasonable time, and allow his invention to go into use. The Judge then reviewed the evidence upon this point.

He further charged, that it did not appear to be denied, that if the plaintiff's patent was valid, that the defendants had infringed it; that the jury were bound, if they found in favour of the plaintiff, to give him a verdict for his actual damages; that in some cases the Court had instructed the jury, that they might, in addition, give damages to compensate the plaintiff for the expenses of the litigation—but that, in the present instance, he thought they ought not to find beyond the actual damages proved. He repeated, that the great question in the cause was, had the plaintiff established his right to the wheel commonly known as "Ericsson's propeller?"

The jury found a verdict for the plaintiff for 3,575 dollars and 6 cents, costs. It is stated that, of the jury, eight were practical mechanics.

The American Screw Steamer "Marmora," me[n]tioned in our last, for the safety of which stro[ng] apprehensions were beginning to be entertaine[d] arrived in the Mersey, from New York, on th[e] morning of Friday, the 26th, after a passage [of] twenty-three days and a half. The length o[f th]e voyage is said to have arisen from injury t[o th]e propeller; it was made of wrought copper; and [be]ing struck by a heavy sea shortly after leaving [N]ew York, it was so much damaged as to be ren[de]red not only useless, but seriously obstructive; i[t wa]s bent out of its position, and had to be dragged [af]te[r] the vessel throughout the greater part of the voy[a]ge. The *Marmora* is handsome in its build. It is [...] g[oing] to Constantinople, and to be placed at the dis[po]sa[l] of the Turkish Government.

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

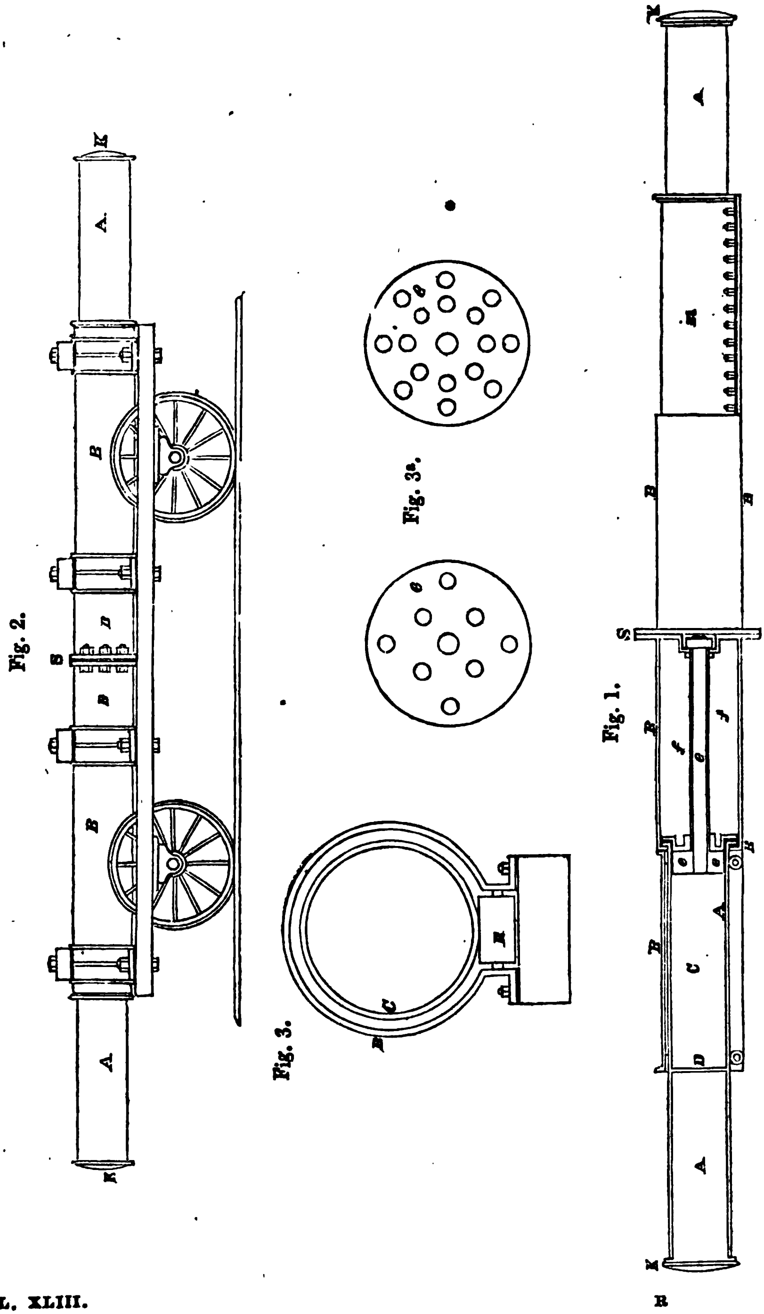
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1157.] SATURDAY, OCTOBER 11, 1845. [Price 3*d*.

Edited by J. C. Robertson, No. 166, Fleet-street.

RAYNER'S PATENT BUFFING APPARATUS.



PREVENTION OF RAILWAY ACCIDENTS—RAYNER'S PATENT BUFFING APPARATUS.

Railway accidents, involving serious loss, both of human life and property, have become so numerous as to excite a large share of public attention and sympathy. When the vast number of travellers is considered in connexion with the long distances daily passed over, together with the comparative infancy of the railway system in general, it becomes a matter of surprise that such a complication of mechanical agency should so successfully perform its allotted duty; and whilst it affords an encouraging demonstration of the amount of safety attainable by mechanical means, the number of casualties arising from the defective nature of human interference, places the uncertainty of the latter prominently in view. It is not intended to be affirmed in any way that mechanical excellence approximates nearer to perfection in opposition to human agency—manifestly not, inasmuch as the efficient action of the former depends upon the skilful administration of the latter. Railways and their several arrangements, in common with many other systems, are a compound of mechanical and human agency, having for their united objects the production of a given effect. The former agency performs its task infallibly, producing the same result so long as the latter presents its co-operator with the like means. Mechanical agency clearly indicates an arrangement of instruments acted upon by certain laws and placed in certain relative positions with especial regard to the attainment of a direct purpose; so far, then, infallibility is affirmed of that agency, for the instruments employed are the servants, and are employed in the current of natural action traversed by immutable principles. The human agent is essentially distinct, operated upon by an endless diversity of circumstances, and necessarily subordinate to none.

Railways, it is to be observed, in their successful working, impose duties upon many tributary laws in the mechanical agent previously unheard of; as well do they demand human interference at given points, in harmony with a system of movements altogether unexampled. The laws which go to make up the former agent govern with as much unerring precision their respective instruments near the boundary as to the spring of their action; it is not so with the latter, he is called upon to counterpart without a knowledge of the principal; he is desired, nay, compelled to predict a consequent to an antecedent never known before. This is literally true of the two agents at present; lapse of time and experience may qualify the imperfections of the latter, and improve the instrumentality of the former, but so long as human interference is essential to the carrying on and working of this system, and that interference liable to error, so long will its mal-administration be productive of irregular and disastrous results.

These remarks are intended to point out the existing necessity for recourse to as large an amount of mechanical contrivance as can be beneficially applied to railway travelling, and by these means to reduce the probability of accident. The collision of trains under various circumstances has proved a prolific source of disaster, both to life and property, and it is to moderate, neutralize if possible, the destructive consequences of collision, that the apparatus, hereafter described, has been designed and arranged. Some conditions seem essential for the accomplishment of this end. The resisting force should be elastic, and its elasticity should be proportioned to the velocity of impact. The resisting power should be gradual and not all exhausted by the first shock or stroke. A collision produces a succession of shocks. The resisting power should be exerted in the plane of direct motion, and allow the train to move through a considerable length of space before coming to rest. The apparatus should admit of adjustment to the average speed and weight of the carriage. It is presumed, that it is not too much to assert, that these apparently requisite conditions are complied with in the accompanying designs.

Description of Rayner's Patent Buffing Apparatus.

Fig. 1 represents a sectional and external view of two buffers placed end to end at S S, and bolted together, so as to support each other lengthways; A A is an iron cylinder divided at D, by a metal plate cutting off the chamber C C, which is kept full of water admitted through a vertical tube passing down the centre of

Fig. 4.

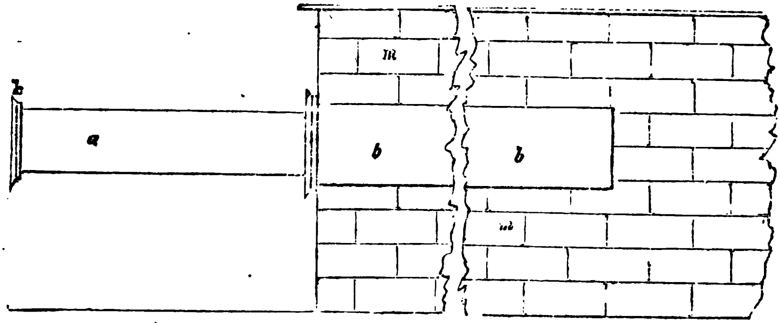


Fig. 5.

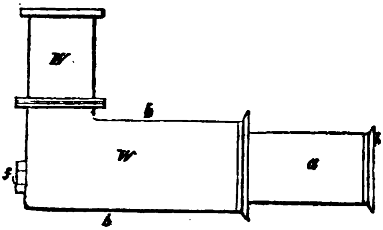
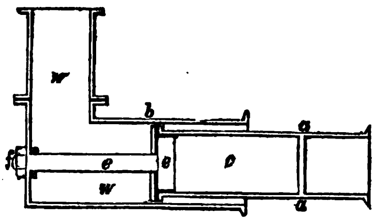


Fig. 6.



the piston, *e e*, and which piston is firmly bolted to the flanch of the outside casing B at S; this outside casing is of iron, and its interior is occupied with atmospheric air, as shown at *f f;* the piston *e* is perforated, as shown at fig. 3, *a*; the apertures may be increased in size, as also in number. The action of the apparatus is as follows: K, the point of contact is struck and forces the cylinder, A A, up into the chamber, *f f*, and outside casing, B B, until the piston bottom, *e*, is in contact with D; this upward, or onward movement is retarded by the hydraulic action of the fluid in C C, the whole contents of which are forced through the apertures in the piston, *e*; the advance of the cylinder, A A, is also opposed by the action of the atmosphere on the upper or inner end of that cylinder. The united resistance of air and water is thus directly obtained. It will be readily perceived, that the size and number of the apertures in the piston, *e*, regulate the resistance of the water, which may be adapted to the vehicle for which it is intended to be used.

Fig. 2 represents a side elevation of two buffers applied to an independent carriage designed to follow the tender, and to be used as a luggage van or truck.

The number of buffers may be increased to four or six on this carriage, and the elastic action they would possess would almost defy mechanical destruction; the cylinders, A A, are kept distended, and ready for use by the pressure of the vertical column of water.

Fig. 7.

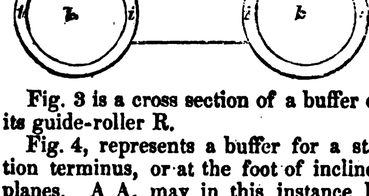


Fig. 3 is a cross section of a buffer on its guide-roller R.

Fig. 4, represents a buffer for a station terminus, or at the foot of inclined planes. A A, may in this instance be prolonged so as to shut up 10 or 20 feet if required; this would be a sure preventive to accident in those cases.

Figs. 5, 6 and 7, represent an application of the buffer to the locomotive

engine—front, side elevation section, and front view; the chamber, W W, is partially filled with water, the resisting power is double-acting—water and air supposed to afford resistance to the superior momentum of the locomotive engine. The length of space through which the resisting power of the apparatus is designed to act in the application of the buffer to carriages, is 3 feet 6 in. at each end, 7 feet in all. A train composed of twenty carriages would thus have a contractile power of 140 feet, a space sufficiently long by the application of a moderate elastic force to neutralize and render harmless the velocity of a fast train heavily laden.

The apparatus is capable of application in various shapes and forms; those indicated in the figures are of a heavy description; a much lighter apparatus is applicable to light carriages constructed for fast travelling.

HENRY RAYNER.

Ripley by Alfreton, Oct. 4, 1845.

ACCIDENTS IN COAL MINES, WITH A PROPOSITION FOR THEIR PREVENTION.

The recent mortality from coal-pit explosions is truly awful and startling; scarcely a month has elapsed since thirty lives were sacrificed at Crombach, in Wales, and more recently above fifty at Jarrow, and five at Aberdare. A year ago, this month, ninety-five were deprived of life at the Haswell colliery, and it is affirmed, by competent authorities, that in this kingdom alone no fewer than two thousand five hundred are lost annually!! These facts call aloud for legislative interference, and appeal to science with a power far beyond that of eloquence. Previously to giving my own, it may be necessary to point out a few of the plans that have been suggested for ridding pits of noxious gases. Before the introduction of Davy's lamp it was proposed to ventilate mines by air pipes passing through all parts of the works to a common tube at the pit's mouth that should be made to feed a fire; the draught occasioned by the fire would serve to clear the mine of all noxious vapour. This mode was again suggested by a writer in Chambers' Journal for 1840. Another practice was for one of the colliers to crawl, serpent like, on his body, and with a match to fire the gases and allow them to explode over him. This latter practice was very dangerous, and the former seems hardly feasible. Illuminating pits with the Bude-light was proposed by its inventor, Mr. G. Gurney. A correspondent in your Magazine for October, 1844, proposed to effect this by having a Bude-light at the bottom of the shaft, and by means of mirrors and lenses, made moveable by being fixed on ball and socket joints, to reflect the light to all parts of the pit; all this is undoubtedly impracticable. A great deal of fault has been placed to Davy's Lamp, which ought to have been laid to the charge of those who had its management. That instrument, as improved by Messrs. Upton and Co., is sure and philosophical, and though it cannot remove the mephitic vapours of a coal pit, it safely and distinctly indicates their nature and presence, and thus makes way for more powerful agents by which they may be expelled. The *Literary Gazette* for July last, contains an abstract of a paper read before the British Association by Professor Ansted "On the Ventilation of Mines." This gentleman proposes, with improvements, what has before been partially practised in some districts, viz.:—the sinking of extra shafts, as vents or chimneys, to the working shafts, and by placing at the bottom of these, furnaces, or grates, or pans of fire, so as to cause a free circulation of air in the paths or galleries of the mines. It will be much to tempt coal owners to sink extra shafts, bearing in mind the following fact stated by the Professor. "The coal trade is now hardly remunerative. It is a struggle in which every one endeavours to bring into the market saleable coal at a low price, and a struggle, obliging those concerned to compete with the utmost energy."—He further adds, "But the interests at stake are not those of moneyed men. The lives of thousands, and the wellbeing of the population of large districts are also involved; and it is the duty of Government to watch over and protect these." Professor Ansted thinks that many miners are killed by the carbonic acid that remains after, and is the effect of the explosion—not being able to make their escape they breathe this noxious gas, which produces immediate death. Carbonic acid gas is rapidly absorbed by water, and could an explosion of fire-damp take place and the

workmen be out of the mine, the moisture of the pit would readily take it up.

The occurrence of fire-damp, or carburetted hydrogen, in coal mines proves that chemical changes are constantly taking place in beds of coal. The gas issues in large quantities from fissures, and by collecting in the mines and natural caverns, owing to deficient ventilation, it gradually mingles with the atmospheric air and forms an highly explosive mixture. The first unprotected light which then approaches, sets fire to the whole mass, and an explosion ensues. There is another noxious gas found in coal pits, wells, and caverns; it is known by the name of choke-damp (chemically, carbonic acid gas;) it is not so dangerous as the former, owing to its incombustible nature, although through it a great number of lives are annually sacrificed.

It is a well known fact that an electric spark explodes gunpowder; could this explosion take place in a volume of fire-damp, large or small, in a mine or cavern, the whole would be exploded:—by pursuing the same plan with choke-damp, or carbonic acid, and taking a larger quantity of gunpowder, the whole of the noxious gas would be driven with great violence up the shaft of the pit, and pure atmospheric air rush in to supply its place. It may be objected that the violence of these explosions would produce a great deal of extra labour, by filling up the gates or hurrying paths with shale and other refuse. My answer is this; if it be an evil, it will be incalculably overbalanced by the good the concussion produces, in breaking down barriers that intercept natural reservoirs of these combustible gases and exploding them. For carrying out these experiments a galvanic or electrical apparatus is indispensable. The conductors are made as follows:—I procure a necessary length of bonnet wire, which is made of brass or iron, wholly surrounded by a strong cotton fibre, and is used to give permanency of shape to bonnets, hence its name; this is enveloped with a viscid solution of caoutchouc, which is a non-conductor; after drying it, the process is repeated, or it is encased with a close fitting web or tube of the same material, previously smeared with the solution. The cotton on the wire serves as a base or foundation for the caoutchouc solution. We thus obtain a flexible conductor, perfectly insulated and impervious to air and moisture, and one that might be used for telegraphic purposes, military and submarine operations, as well as for works of mining and quarrying.

This conductor, when used, is affixed to the positive end of the electrical apparatus—at other times it remains as a fixture down the shaft of the mine properly secured by wooden holdfasts;—it is also extended along the paths or gates of the pit, being intercepted at proper distances and the interceptions knobbed with small brass balls about half an inch apart; these knobs are to be surrounded by small tubes of caoutchouc, containing finely grained gunpowder, and tightly secured with waxed cord or thread around the necks of the knobs. The continuation of this portion of the conductor, like the other, is fixed along the shaft of the mine, and when used, attached to the negative end of the galvanic apparatus.

Choke-damp in wells may be removed by discharging an ounce or two of gunpowder from a common firelock into the well; or by attaching a fuse to a small quantity of gunpowder, and lowering it into the well and allowing it to explode.

After the description I have given of the proposed apparatus for exploding or expelling noxious gases from pits and mines, it will be unnecessary to state that it is meant to be a fixture, and that after every trial of its effects it will be necessary to charge a caoutchouc tube with gunpowder and attach it to the knobbed interceptors of the main conductor, to be in readiness in case of an escape of gas into the mine, when indicated by Davy's lamp.

JOHN MILLIGAN, Surgeon.

Keighley, Sept. 30th, 1845.

CASK GAUGING.

In the *Mechanics' Magazine*, No. 849, there is an article by Mr. Woolgar, of Lewes, entitled "The Calculator, No. 6,—extension of power in the sliding rule," in which he has at No. 2, on "Cask Gauging," taken up the principle previously laid down by Mr. Lowry, and Dr. Hutton, and applied it to the sliding rule for the above purpose. But notwithstanding its apparent simplicity, perhaps some of your readers may have lost, or not perceived the *value* of the

principle, from the fact of Mr. Woolgar having treated the subject in his own peculiar scientific style.

The formula for the graduation of the line, to which reference is thus made, is as under, viz.—

		Measuring Valves.		
		a	y	z
1st variety	$\frac{1}{4}s \times (x + yq^2 + zq)$ . .	2·	1·	0·
2nd variety	$\frac{1}{4}s \times (x + yq^2 + zq)$ . .	1·6	0·6	0·8
Dr. Young's variety	$\frac{1}{4}s \times (x + yq^2 + zq)$ . .	1·4	0·6	1·0
Dr. Hutton's variety	$\frac{1}{4}s \times (x + yq^2 + zq)$ . .	1·3	0·83	0·87

$$s = 353\text{·}036 \quad q = \frac{H}{B}$$

or, numerically, supposing the $\frac{H}{B} = \text{·}60$

1st var. $\frac{1000000}{1059108} = 000944 \times (x = 2. \ + yq^2 = \text{·}360 + zq = 0)$

2nd var. $\frac{1000000}{1059108} = 000944 \times (x = 1\text{·}6 + yq^2 = \text{·}216 + zq = \text{·}48)$

Dr. Y.'s var. $\frac{1000000}{1059108} = 000944 \times (x = 1\text{·}4 + yq^2 = \text{·}216 + zq = \text{·}60)$

Dr. H.'s var. $\frac{1000000}{1059108} = 000944 \times (x = 1\text{·}3 + yq^2 = \text{·}2988 + zq = \text{·}522)$

But as I have generally found example of considerable advantage for the purpose of communications, I shall avail myself of that method.

Example.

Again, supposing the $\frac{H}{B} = \text{·}60$

1st va. $\frac{1000000}{1059\text{·}108} = 000944 \times 2\text{·}360 = 0022283 = \log. \text{·}347915$

$x = 2\text{·}0$
$yq^2 = \text{·}360$
$zq = \text{·}000$

2·360

log. 1·00000
log. ·347915

g. points

log. ·652085 ÷ 2 = log. ·326042 = 21·18

2nd va. $\frac{10000000}{1059\text{·}108} = \text{·}000944 \times 2\text{·}296 = \text{·}0021679 = \log. \text{·}335859$

$x = 1\text{·}6$
$yq^2 = \text{·}216$
$zq = \text{·}480$

2·296

log. 1·000000 − log. ·335859 = log. ·664141 ÷ 2 = log. ·332070 = 21·48 the gauge point.

The gauge points for the other varieties are found by a similar process, using their respective coefficients, or values.

The measuring values increase, at every increase of the quotient of the $\frac{H}{B}$.

To this principle of cask gauging, Dr. Hutton assigns the highest rank for accuracy and facility.

This principle, (which is termed the line "x") has been recently graduated, according to the different varieties, upon the sliding rule, for the benefit of excise officers, by Messrs. Dring and Fage, 19, Tooley-street, London; it is very simple, concise, and accurate in its application.

The proportion is, as bung diameter

on B : the head diameter on A : : unity on B : the gauge point above the line A on x; then as the length of the cask on C : the gauge point (thus found) on D : : the bung diameter on D : the content of the cask on C.

There is in the foregoing formula a *range* of gauge points including the spheroidal curve, down to that by Dr. Hutton, which I know from some considerable experience, to be vastly superior to the arbitrary system laid down upon the head rod of the callipers, by reducing the cask to a cylinder, which it is well known, by those who are concerned, cannot be done with *accuracy* in one to fifty or more cases.

JOHN WHITFORD.

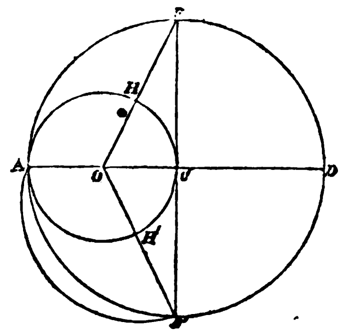
Wirksworth, 1st Oct., 1845.

SOLUTION OF A PROBLEM IN MENSURATION.

The following neat exercise was recently proposed in a contemporary periodical work; but no solution of it was given. A correct solution will probably be interesting to some of the readers of the *Mechanics' Magazine.*

PROBLEM.—"A horse was tethered to the wall of a circular garden; the length of the tether was equal to the circumference of the garden, and the horse had the range of an acre of the surrounding field: find the diameter of the garden."

SOLUTION.—Let A H C H′ be the wall, and C the point to which the tether



is fixed in the wall. Then the acre of grass is composed of the semicircle described on B B′ (the length of the semicircular wall), together with the areas of the involutes CBAHC and CB′AH′C.

Put OC the radius of the garden, and denote by π the circumference of the circle to diameter unity; then (*Hutton's Course*, 12th ed., vol. ii., p. 529) we have

$$\text{Area AOB} = \frac{(\pi x)^3}{6x} = \frac{\pi^3}{6} \cdot x^2$$

$$\text{Area BOC} = \tfrac{1}{2}.\text{OC. OB} = \frac{\pi}{2} . x^2$$

$$\text{Area AHC} = \quad = \frac{\pi}{2} . x^2$$

Whence,

$$\text{AHCB} = \text{AOB} + \text{BOC} - \text{AHC} = \frac{\pi^3}{6} . x^2;$$

and the double of this, or $\frac{\pi^3}{3} . x^2$ = area of the field to the left of BB′.

Also,

$$\text{Area BDB}' = \tfrac{1}{2}(\pi x)^2\pi = \tfrac{1}{2}\pi^3 x^2;$$

whence the whole area within range of the tether is

$$(\tfrac{1}{3} + \tfrac{1}{2})\pi^3 x^2 = \frac{5\pi^3}{6} x^2 = 4840,$$

by the question. Wherefore we have $x^2 = \frac{5808}{\pi^3}$ yards.

The simplest mode of computation is by logarithms, since log. π is given accurately in Hutton's Tables, p. 368.

$$\begin{array}{rl}
\log. \pi = & 0{\cdot}4971499 \\
 & 3 \\
\hline
\log \ \pi^3 = & 1{\cdot}4914497 \\
\log \ 5808 = & 3{\cdot}7640266 \\
\log \ \pi^3 = & 1{\cdot}4914497 \\
\hline
 & 2)2{\cdot}2725769 \\
\hline
\log x = & 1{\cdot}1362885,
\end{array}$$

and $x = 27{\cdot}3728$ yards.

CENTURION.

Home, September 22, 1845.

THE ATMOSPHERIC RAILWAY—THE DOUBLE VALVE.

Sir,—In reply to the polite request of Mr. Lipscombe, I should have been most happy to forward a description of a double valve, acting in the manner I proposed, but it would be only occupying your space unnecessarily, as a model was exhibited to the Parliamentary Committee on the Portsmouth line; and, I believe, a patent has been taken out for it. It is as simple as ingenious; and, although only intended for the separating valves, may, by a slight modification, be adapted to the purposes I proposed. Three or four practicable methods have been advanced, but experience alone will prove which may be preferable in action.

I remain, Sir,

Your obedient servant,

R. W.

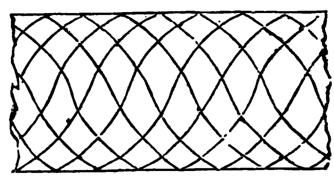
SUBMARINE RAILWAYS AND TUBULAR SUSPENSION BRIDGES.

While the construction of suspension bridges is causing considerable attention, I would crave permission to make a few remarks on the subject by the medium of the *Mechanics' Magazine.*

That greater perfection can be attained in the construction of bridges seems unquestionable, and the numerous accidents which have taken place may show that considerable improvements are required; certainly we are told that these accidents do not affect the principle on which they are built; still this does not prove that bridges cannot be constructed on a principle which would preclude the possibility of their being injured by ordinary casualties; I use the term ordinary, for the causes which have destroyed several bridges were in themselves so trivial that a repetition of these terrible accidents is not impossible. But it is said that these accidents resulted only by an error in construction; may it not, however, be argued that the principle is in such a nature as to render it extremely difficult to construct a suspension bridge in perfection? An imperfect joint, for instance, in welding the iron shafts, may be the cause of a number of lives being lost. Supposing a collision of two trains were to take place on a suspension bridge, the shock would be so terrible that in all probability the bridge would give way and cause an accident still more frightful than the first. Apart from casualties, a suspension bridge may possibly be constructed firmly; but casualties will happen in spite of all possible precaution.

I do not, however, make these remarks with a view of merely finding fault with the principle of constructing suspension bridges, but as an apology for proposing an amendment, or at least what I consider to be one. In a former Number I explained that a tube, with a platform above, might be suspended as a bridge; if constructed, however, as an ordinary tube, it is probable that it would not be sufficiently strong to bear a heavy railway train. To depend on the strength of the plates forming the tube would be an erroneous theory; it is by the form of the skeleton work of the tube that the main strength can be gained. I would construct the framework in the form of the screw, that is, I would interpose a number of strong wrought-iron spirals, so as to form a cylindrical net, as represented in fig. 1. I would then place a

Fig. 1.



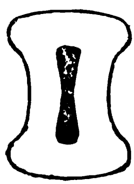
few longitudinal iron shafts inside, and then rivet thick wrought-iron plates outside, and if necessary, inside also. I consider that any amount of strength can be obtained by increasing the number of iron spiral ribs. Another additional method would be to construct the bridge in the form of an arch, that is, to build it in the shape of a bent tube; a very slight curve would probably add very considerably to its strength, and by increasing the curve and the thickness of the spiral ribs, an almost unlimited strength might be obtained.

There would be no great difficulty in making an experiment on a small scale to test the strength of such a bridge, by making a small cylinder with spiral ribs; of course, strictly preserving the proportion.

In many cases, it is probable that a platform placed on two such tubes, of a smaller diameter, would answer for a common road, though perhaps not for a railway. Modifications might be made in the form of the bridge according to the locality.

I may here make a remark on cast-iron shafts, and steam-engine lever beams, &c. It is frequently complained that they are liable to break by their brittleness; wrought-iron has been repeatedly proposed, but is objectionable on account not only of its greater cost, but of its pliability. I think it would be possible to remedy this inconvenience by placing a wrought-iron bar inside, as represented in fig. 2: it is probable that the brittleness of the one would be counteracted by the pliability of the other.

Fig. 2.



The further details on the construction of submarine railways, I will explain in my next communication.

I remain, respectfully,

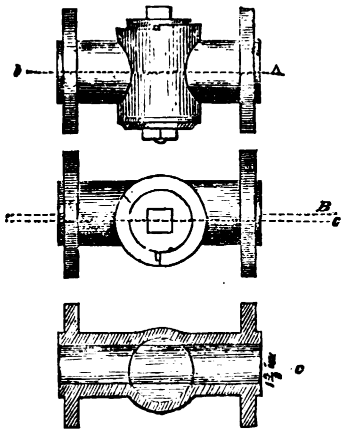
JOHN DE LA HAYE.

9th mo., 18th, 1845. London-road, Liverpool.

P. S.—I have not lost sight of the fact that George Stephenson was the first who proposed to suspend a wrought-iron tube; but as in this case he did nothing more than give a lift to my iron tunnel, without proposing any modification in the form and mode of construction, I presume that I may claim the *Tubular Suspension Bridge* as my invention.

IMPROVEMENT IN TAPS.

Sir,—Requiring some taps lately for an experimental purpose, I found those bought in the shops, though sufficiently expensive, of no use whatever on account



of the *bore* being so small in proportion to the size of the barrel of the tap. I therefore had a pattern made with the alteration shown in the above figures, which are ¼th the full size of the tap made. It will be seen at once that the alteration is simply putting the barrel on one side, so as to get more metal on one side of the tap than on the other, and I find it answer completely. I suppose such a tap must have been made before, though I have never seen one myself, it being quite original with me. In the figure, A is the elevation of the tap barrel; B, the plan showing the line *c*, in which the pipe is mortised, and C, the horizontal section on the line *b*. The tap is open in all the engravings, and the bore is 1⅜ in.

I remain your subscriber,

W. H. R—N.

RAILWAY TURN-TABLES.

Sir,—A Mr. Samuel Ellis, of Salford, Manchester, sealed a patent in June, 1843, for a new sort of Railway Turn-table. See *Repertory of Arts*, for March 1845. There are five claims—and the principal novelties consist in combining a weigh bridge with the turn-table, and in so supporting the platform of the table, by a *system of levers and crane work*, that it can be lifted up when about to traverse, and lowered back again, " upon a fixed stationary bed or bearing, upon which it firmly rests all round."

The whole specification is given at

length in the *Repertory*, and not one word occurs therein, as to any other mode of lifting or lowering the table than by the clumsy levers and wheel work described and claimed.

Mr. Ellis has, within a short time, erected a large turn-table upon the Drogheda Railway—labelled duly on top in iron letters, "Ellis's Patent"—but to my surprise, I observe he has abandoned all his own arrangements, and adopted, without acknowledgment, *my method* of supporting and lifting the table, by making the lower pivot the cylinder of an hydraulic press, as figured and fully described by me in your Magazine for August 20, 1842, No. 993. The arrangements are absolutely identical. This cool piece of dishonesty and plagiarism, I think deserves showing up; and allow me to ask, whether a party, labelling an article as his patent, for which he has none, as in the present case, is not liable to a rather serious fine, under Lord Brougham's amendment to the patent law?

The table in question would act well, if the workmanship of the hydraulic part of it were as good as the design, which is not the case. As to the combination of the turn-table and weighing machine, however, there never was a more preposterous idea, as the experience of one on the Drogheda line sufficiently proves. The principle of every good balance, of whatever size, should be that of minimum weight in proportion to the load to be weighed. One might have fancied, that the heavier it could be made the better, from the load of levers and bars, and so forth, under which these affairs groan.

Yours obediently,

ROBERT MALLET.

Dublin, October 6, 1845.

PROFESSOR MORSE'S ELECTRIC TELEGRAPH.

[Extract from a letter addressed by Professor Morse to the Secretary of the United States Treasury.]

That which seemed to many chimerical at the time, is now completely realized. The most sceptical are convinced; and the daily and hourly operations of the telegraph, in transmitting information of any kind, are so publicly known, and the public feeling in regard to it so universally expressed, that I need here only give a few instances of its action, further to illustrate its character.

The facts in relation to the transmission of the proceedings of the Democratic Convention at Baltimore, in May last, are well known, and are alluded to in my report to the department, June 3, 1844. (House Doc. No. 270, 28th Cong., 1st sess.) Since the adjournment of Congress in June last, and during the summer and autumn, the telegraph has been in constant readiness for operation, and there has been time to test many points in relation to it, which needed experience to settle.

For more, now, than *eight months*, the conductors for the telegraph, carried on elevated posts for forty miles, have remained undisturbed from the wantonness or evil disposition of any one. Not a single instance of the kind has occurred. In several instances, indeed, the communication has been interrupted by accidents, but then only for a very brief period.

One of these was by the great fire in Pratt-street, Baltimore, which destroyed one of the posts, and consequently temporarily stopped the communication; but in two or three hours the damage was repaired, and the first notice of the accident, and all the particulars, were transmitted to Washington by the telegraph itself.

Another instance of interruption was occasioned by the felling of a tree, which accidentally fell across the wires, and at the same time across the railroad track—stopping the cars for a short time, and the telegraphic communication for two hours.

Excepting the time excluded by these, and two or three other similar accidental interruptions, and which, during seven months of its effective existence between the two cities, does not altogether amount to more than twenty-four hours, the telegraph has been either in operation, or prepared for operation, at any hour of the day or night, irrespective of the state of the weather.

It has transmitted intelligence of the greatest importance. During the troubles in Philadelphia the last summer, sealed despatches were sent by express from the mayor of Philadelphia to the President of the United States. On the arrival of the express at Baltimore, the purport of the despatches transpired; and while the express train was in preparation for Washington, the intelligence was sent to Washington by telegraph, accompanied by an order from the president of the railroad company to prevent the Washington burden train from leaving until the express should arrive. The order was given and complied with. The express had a clear track; and the President and the cabinet being in council, had notice both of the fact that an express was on its way with important despatches for them,

and also of the nature of the despatches; so that, when the express arrived, the answer was in readiness for the messenger.

In October, a deserter from the United States ship *Pennsylvania*, lying at Norfolk, who had also defrauded the purser of some 600 or 700 dollars, was supposed to have gone to Baltimore. The purser called at the telegraph office in Washington, stated his case, and wished to give notice in Baltimore, at the same time offering a reward for the apprehension of the culprit. The name and description of the offender's person, with the offer of the reward, were sent to Baltimore, and in ten minutes the warrant was in the hands of the officers of justice for his arrest; and, in half an hour from the time that the purser preferred his request at Washington, it was announced from Baltimore by the telegraph, "The deserter is arrested; he is in jail. What shall be done with him?"

To show the variety of the operations of the telegraph, a game of drafts and several games of chess have been played between the cities of Baltimore and Washington, with the same ease as if the players were seated at the same table. To illustrate the independence of the telegraph of the weather and time of day, I would state that, during the severe storm of the 5th of December, when the night was intensely dark, the rain descending in torrents, and the wind blowing a gale, it seemed more than ordinarily mysterious to see a company around a table in a warm retired chamber on such a night in Washington, playing a game of chess with another company similarly situated in Baltimore—the darkness, the rain, and the wind being no impediment to instantaneous communication.

In regard to the quantity of intelligence which may be sent in a given time, it is perfectly safe to say that thirty characters can be transmitted in a minute by a single instrument; and, as these characters are conventional signs, they may mean either *numbers*, *letters*, *words*, or *sentences*.

As an illustration of this point, I will state that nearly a whole column (more than seven-eighths) in the *Baltimore Patriot* was transmitted in thirty minutes—faster than the reporter in Baltimore could transcribe.

This fact bears upon the ability of producing a revenue from the telegraph; and I would suggest the propriety of permission being granted by Congress to the department to adjust a tariff of charges on intelligence sent by telegraph, at such a rate of postage as shall at least return to the treasury the interest of the capital expended in the first construction and the after maintenance of the telegraph.

* * * *

In the absence of experience, the expense necessary to construct and to maintain a system of electro-magnetic telegraphs was thought to be so great as to present a formidable, if not an insurmountable, obstacle to its adoption. But the experiment already made for forty miles has shown that the electro-magnetic telegraph is far from being expensive either in its first construction or after maintenance, especially when its vast superiority over the old system is taken into consideration.

To make this more clear, I give an abstract both of the expenses and capacities of the ordinary visual telegraphs in some of the European countries.

In England, the semiphore telegraph established between London and Portsmouth (a distance of seventy-two miles) is maintained by the British Government at an average expense of 3,405*l*., or 15,118 dollars per annum. From a return (vol. 30, 1843, accounts and papers of House of Commons,) of the number of days during which the telegraph was *not available* on account of the weather during a period of three years, it appears that there were in that time 323 days in which it was useless, or nearly *one year out of three!* But by a return made to the Admiralty of the number of hours in the day appointed for working the telegraph, it appears that the hours appointed for the year are—from the 1st of October to the 28th of February, from 10 o'clock A.M., to 3 P.M.—5 hours; from the 1st of March to the 30th of September, from 10 o'clock A.M., to 5 P.M.—7 hours.

Average number of hours per day in the most favourable weather, 6 hours!

Deducting one year from the three for unavailable days, the average time per day for the three years would be but 4 hours. So that for the use of their telegraph for seventy-two miles, and for only 4 hours in the day, the British Government expend 15,118 dollars per annum.

The French system of telegraphs is more extensive and perfect than that of any other nation. It consists at present of five great lines extending from the capital to the extreme cities of the kingdom, to wit:

	Miles.
The Calais line, from Paris to Calais	152
The Strasbourg line, from Paris to Strasbourg	255
The Brest line, from Paris to Brest .	325
The Toulon line, from Paris to Toulon	317
The Bayonne line, from Paris to Bayonne	425

—making a total of 1,474 miles of telegraphic intercourse. These telegraphs are maintained by the French Government at an annual expense of over 1,000,000 of francs, or 202,000 dollars.

The whole extent, then, of the French lines of telegraph is 1,474 miles, with 519 stations; and, (if the estimate for six stations, at an average cost of 4,400 francs, is a criterion for the rest) erected at a cost of at least 880 dollars each—making a total of 456,720 dollars.

The electro-magnetic telegraph, at the rate proposed in the bill, (to wit, 461 dollars per mile, and which it should be remembered will construct not *one* line only, but *six*,) could be constructed the same distance for 619,515 dollars—not one-third more than the cost of the French telegraphs. Even supposing each line to be only as efficient as the French telegraph, still there would be six times the facilities for not one-third more cost. But when it is considered that the French telegraph, like the English, is unavailable the greater part of the time, the advantages in favour of the magnetic telegraph become more obvious.

An important difference between the two systems is, that the foreign telegraphs are all a burden upon the treasury of their respective countries; while the magnetic telegraph proposes, and is alone capable of sustaining itself and of producing a revenue.

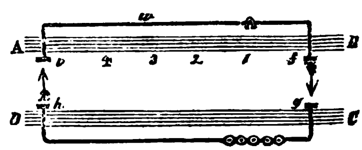
Another difference in the two systems is, that the stations in the foreign telegraphs must be within sight of each other: a fact which bears essentially on the cost of maintenance. The French telegraph requires for the distance of 1,474 miles, no less than 519 stations—averaging *one for about every three miles*. The number of stations of the magnetic telegraph, on the contrary, is optional. The two stations (one only at Baltimore and one at Washington) show that they may be at least 40 miles apart, and there is no reason to doubt, from experiments I have made, that 100 miles, or even 500 miles, would give the same results. In the maintenance, therefore, of stations, the magnetic telegraph would require but 15 stations, (assuming that 100 miles is the *utmost limit* of transmission between two stations, which is not probable;) while the French requires 519 for the same distance.

When to this are added the facts, that the magnetic telegraph is at *all times available*, at *every hour of the day or night*, *irrespective of weather*: that, in comparison with the visual telegraphs, it communicates *more than a hundredfold* the quantity of intelligence in the same time; that it is originally constructed at a *less cost (all things considered;)* that it is *maintained for less*; and that it is capable, by a rate of charges for transmitting intelligence, not only of defraying all its expenses, but, if desired, of producing a revenue; I may be permitted to hope that, when these great advantages are fully understood, my system will receive that attention from the Government which its intrinsic public importance demands.

* * * *

In the autumn of 1842, at the request of the American Institute, I undertook to give to the public in New York a demonstration of the practicability of my telegraph, by connecting Governor's Island with Castle Garden—a distance of a mile; and for this purpose I laid my wires properly insulated beneath the water. I had scarcely begun to operate, and had received but two or three characters, when my intentions were frustrated by the accidental destruction of a part of my conductors by a vessel, which drew them up on her anchor and cut them off. In the moments of mortification, in a sleepless night, I devised a plan for avoiding such an accident in future, by so arranging my wires along the banks of the river as to cause the water itself to conduct the electricity across.

The experiment, however, was deferred till I arrived at Washington; and on Dec. 16th, 1842, I tested my arrangement across the canal, and with success. The simple fact was then ascertained, that electricity could be made to cross a river without other conductors than the water itself; but it was not until the last autumn that I had the leisure to make a series of experiments to ascertain the law of its passage. The following diagram will serve to explain the experiment.



A, B, C, D, are the banks of the river; N P, are the batteries; E, is the electro-magnet; *w w*, are the wires along the banks, connecting with copper plates *f*, *g*, *h*, *i*, which are placed in the water. When this arrangement is complete, the electricity generated by the battery, passes from the positive pole P, to the plate *h*, across the river, through the water to plate *i*, and thence around the coil of the magnet E, to plate *f*; across the river again to plate *g*, and thence to the other pole of the battery N. The numbers 1, 2, 3, 4, indicate the distance along the bank, measured by the number of times of the distance across the river.

The distance across the canal is 80 feet; on August 24th, the following were the results of the experiments :—

No. of the Experiment.	No. of Cups in Battery.	Length of conductors w,w.	Degrees of motion of Galvanometer.	Size of the Copper Plates, f, g, h, i.
1	14	400	32 & 24	5 by 2½ ft.
2	14	400	13½ & 4½	16 „ 13 in.
3	14	400	1 & 1	6 „ 5 in.
4	7	400	24 & 13	5 „ 2½ ft.
5	7	300	29 & 21	5 „ 2½ ft.
6	7	200	21½ & 15	5 „ 2½ ft.

Showing that electricity crosses the river, and *in quantity in proportion to the size of the plates in the water*. The *distance of the plates on the same side* of the river *from each other*, also affects the result. Having ascertained the general fact, I was desirous of discovering the best practical distance at which to place my copper plates; and, not having the leisure myself, I requested my friend, Professor Gale, to make the experiments for me. * * * *

As the result of these experiments, it would seem that there may be situations in which the arrangements I have made for passing electricity across the rivers may be useful, although experience alone can determine whether lofty spars, on which the wires may be suspended, erected in the rivers, may not be deemed the most practical. The experiments made were but for a short distance; in which, however, the principle was fully proved to be correct.

It has been applied, under the direction of my able assistants, Messrs. Vail and Rogers, across the Susquehannah river, at Havre-de-Grace, with complete success—a distance of nearly a mile.

I have as yet said nothing on the telegraph as a mighty aid to national defence. Its importance in this respect is so obvious, that I need not dilate. The importance generally to the Government, and to the country, of a *perfect* telegraphic system, can scarcely be estimated by the short distance already established between Baltimore and Washington; but when all that transpires of public interest at New Orleans, St. Louis, Pittsburg, Cincinnati, Buffalo, Utica, Albany, Portland, Portsmouth, Boston, New York, Philadelphia, Baltimore, Washington, Norfolk, Richmond, Charleston, Savannah, and at all desired intermediate points, shall be *simultaneously* known in each and all these places together,—when all the agents of the Government in every part of the country are in instantaneous communication with head-quarters,—when the several departments can at once learn the actual existing condition of their remotest agencies, and transmit at the moment their necessary orders to meet any exigency,—then will some estimate be formed both of the powers and advantages of the magnetic telegraph.

OTLEY CHEVIN STONE.

This stone is produced from a quarry near Leeds, in Yorkshire. It possesses many advantages, which particularly recommend it for use in the erection of private or public buildings, intended to combine solidity and splendour. It is as durable as granite, absorbs scarcely any moisture, presents a beautiful surface, and is not liable to discoloration by the influence of the atmosphere. A sample of it has been subjected to the test of MM. Vicat, Billandel and Courard, by Dr. Ure, who has expressed a most conclusive opinion in its favour. Among other things, the Doctor states, that, "it is, in fact, a siliceous grit, so closely aggregated, and so devoid of fissures, as to bid defiance to the tooth of time, and, therefore, admirably adapted for every architectural purpose, where strength and durability are the great requisites."

To the above may be added, that, from its great capability of resisting heat, it is an excellent fire-stone, and consequently, adapted for many chemical purposes. These few remarks are founded upon testimonials from various practical and eminent authorities, and have been penned with a view to bring so valuable an acquisition into more general notice, believing we are thus consulting the public advantage as much as the individual interest of the proprietors.—*From a Correspondent.*

THE METHOD OF OBTAINING VACUUM BY THE DIRECT ACTION OF STEAM.—MR. MALLET'S AND MR. NASMYTH'S CLAIMS.

Sir,—Permit me to make a few remarks in your pages upon the observations you have lately made therein as to my claims of priority to Mr. Nasmyth

in the invention of the method of obtaining vacuum for use on atmospheric railways by the direct action of steam. You say "clearly Mr. Nasmyth is the first inventor because he was the first to publish what I so carefully kept secret," &c. In this you appear to me to lose sight of the distinction between the first inventor in the eye of the patent law and the first inventor, *de facto*, the man who is entitled to the right of credit for the invention, although positively deprived of the power of being remunerated by it. Thus, for instance, it is well known that Watt invented the crank motion of the steam engine, although it was patented by a faithless workman who stole his idea, and who became the inventor in the eye of the law, and whose monopoly obliged Watt to patent the sun and planet motion.

Now the facts of the present case stand thus: I had communicated my plans for vacuum by direct action of steam to several persons in this country LONG prior to Mr. Nasmyth's patent, and I am also in a position to *prove* that I had communicated my plans to at least four persons resident in England, not consulted for the sake of maturing invention or the like, long before the date of his patent; and I may further state now, that prior to his specifying, Mr. Nasmyth and I compared notes as to our respective views, which were found singularly coincident.

I do not know what amount of publicity, or communication, constitutes legal publication of an invention, but I presume the above does, and if so, I am first inventor, even in the eye of the law; and, should this be so, of course, the patent is worth nothing. I have, however, neither wish nor intention of depriving Mr. Nasmyth, whose acquaintance I honour, and whose ingenuity I admire, of the fruits of his, as I believe, independent re-invention of what I had before him also independently discovered—but I do claim the merit (if any there be) of first inventor; and although I cannot expect that Mr. Nasmyth should destroy his own patent by admitting this,—yet I shall be curious to see any proof advanced by him that he ever entertained any thoughts of the use of direct-acting steam for procuring vacuum for atmospheric railways, prior to the date of my Report on the subject, or even six months before the sealing of his patent. Silence in this case must indicate that Mr. N. is too candid to attempt an unsupportable case; but if such proofs are proposed being adduced, I shall be ready to lay mine before the public, and let the patent bide the consequences.

I have only to add, as to one other of your remarks, that you are quite right in assuming that the sealed packet before the Royal Irish Academy alluded to by me, contained my three reports, as lately printed by Mr. Weale, word for word.

I am, Sir, yours obediently,

ROBERT MALLET.

Dublin, October 7, 1845.

PREVENTION OF RAILWAY ACCIDENTS.

Major-General Pasley, the Government Inspector of Railways, accompanied by Dr. Melson and Mr. M'Connell, superintendent of the locomotive department of the Bristol and Birmingham railway, recently visited Shadwell-street Mills, Birmingham, for the purpose of witnessing Mr. George Heaton's experiments with regard to the prevention of railway accidents. The following results have since been communicated by Dr. Melson:—

The series of experiments was performed by means of a model, having a shaft or axle, 4 feet 8½ inches in length, and three quarters of an inch in diameter, which had a steel rod 3 feet 1½ inch in length, and 5-16 inches thick, (No. 1 wire gauge,) passing through each end of it—the axle representing in width the narrow-gauge rail, and the steel rods the wheel of a carriage. Near the extremities of these steel rods were attached one pound weights, to give momentum, a small projection being left at each end for the purpose of the attachment of small weights, of three ounces each, by which the wheels may be placed in balance, or variously out of balance, at the pleasure of the experimenter. To give motion to these wheels a string is wound around the centre of the axle until there is a sufficient length to allow a weight attached to the end of it to fall 6 feet 1½ inch. The whole is attached to a frame-work, which renders apparent the amount of oscillation observable under the various conditions of balance or want of balance, the weight attached to the string representing the moving force.

EXP. 1.—Moving force, 12 lbs. Both ends of the transverse rods in perfect balance, each end carrying 1 lb. 3 oz. The wheel revolved 139 times in 1 min. 55 sec. Motion—Equable.

2.—Moving force 12 lbs., each rod being 6 oz. out of balance on the same side of the axle. 133 revolutions in 1 min. 40 sec. Motion—Jumping, the framework moving up and down without oscillation.

3.—Moving force, 18 lbs. Other conditions as in the last experiment. 1 min. 43 sec. revolutions in 1·43. Motion—Much more "jumping."

4.—Moving force, 12 lbs., each rod being 6 oz. out of balance on contrary sides of the axle. 90 revolutions in 1 min. 42 sec. Motion—Twisting or wriggling.

5.—Moving force, 12 lbs. One rod 1 lb. 3 oz. at each end, the other rod 1 lb. 6 oz. at one end, and 1 lb. at the other. 113 revolutions in 1 min. 40 sec. Motion—Twisting with that end which was out of balance.

6.—Moving force, 12 lbs. The rods individually in balance, but one rod 12 oz. heavier than the other. 136 revolutions in 1 min. 51 sec. Motion—Steady.

7.—The fourth experiment repeated, with moving force of 6 lbs. 88 revolutions in 1 min. 40 sec. Motion—Slightly wriggling.

8.—Moving force, 6 lbs., rods in balance. 83 revolutions in 1 min. 32 sec. Motion—Equable.

THE AMERICAN STEAM-SHIP MASSACHUSETTS, AND THE STEAM ENGINE AND SCREW AS AUXILIARIES TO NAVIGATION.

(From the *Liverpool European Times*.)

The steam-ship *Massachusetts* arrived here on Friday last, after a passage of 17½ days, from New York; she is a new and beautiful vessel, rigged for a sailing ship, with the addition of a screw propeller. Her first passage across the Atlantic proved most satisfactory in every respect. When off Liverpool, the following letter was addressed to Mr. Forbes, and other proprietors of the ship, by Colonel Perkins of Boston, and the other passengers on board. The testimony of so able and experienced a gentleman as Colonel Thomas H. Perkins, is of the first importance. He has been one of the greatest travellers by sea and land, and after a long and honourable life devoted to commerce, he again, at the advanced age of 80 years, visits Europe with a view of further extending the commerce and intercourse of the two countries.

"Liverpool, Oct. 3, 1845.

"My Dear Sirs,—I feel that it is due to you, that I should give my opinion on the subject of combining sailing and steaming in merchant ships, and of the success of your undertaking it is that I now address you.

"As a sailing ship, I consider the *Massachusetts* as perfect for the merchant service as any one I have ever seen or had report of; going 10 knots by the log, I have never seen her wet the forecastle or the quarter deck. She goes through the water with less of discomfiture to passengers than it has been my fortune to meet with, although this is the nineteenth passage between the United States and Europe, which I have always made either in the packet ships, or in those of the late firm of James and T. H. Perkins, which latter being employed in the China trade, have always been considered as of the first class.

"Her rig, too, I consider very superior to the old-fashioned mode of rigging ships, as less labour is required in bracing yards, and making and taking in sail.

* * * *

"As respects the auxiliary aid of steam, in cases of light winds or calms, it has answered my most sanguine expectations. In referring to the diary which I have kept, I find that we have used steam, either with sails or alone, 10 21-24 hours, using about 7 to 8 tons of anthracite coals per day; we have made, against light winds dead a-head, or calms on the days on which we used steam, 151 to 158 miles per day, without steam we should have done little or nothing.

"As respects the noise of the steam machinery: having made a passage with that excellent commander, Captain Judkins, in one of the British and North American Royal Mail line, I am of opinion, that although my state-room is directly over one of the cylinders, I was less annoyed than in the steamer alluded to; the room is much more convenient than the one I occupied in her. I have passed much of my time in the ladies' cabin, and am satisfied that the noise and jar there is less from the motive power than in most sailing vessels when going eight or nine knots, when these accommodations were in the after part of the ship.

"We have seen the advantages to-day of the propeller, in getting to Liverpool from Holyhead; the wind (after passing Great Ormshead) was directly adverse, and vessels in company there cannot arrive to-day, which would have been our fate had we no means but our sails to forward us. We came up the Mersey at the rate of seven miles per hour, against a head wind of considerable strength.

"With my best wishes that all your undertakings may be attended with as much success as the one I have been witness of, I am, dear sirs, your obedient servant,

"T. H. PERKINS.

"To R. B. Forbes, Esq., and Owners of ship *Massachusetts*."

MR. ETZLER'S "IRON SLAVE."

Last week, a public trial of the "Satellite," or "Iron Slave," invented by J. A. Etzler, Esq., and constructed by Mr. Atkins, engineer of Bicester, for the Tropical Emigration Society, was made in the neighbourhood of Bicester, Oxfordshire. Early in the morning a few shots were fired, and the bells of the church rung; and, in the afternoon, about 800 persons were assembled on the "Satellite-field," (christened for the occasion) amongst whom we observed many of the neighbouring gentry, to witness the first public display of this invention, which, at no distant period, will change the system of agricultural labour, especially in warm climates, and substitute iron slaves for human slaves. The machine is intended for agricultural purposes, such as ploughing, sowing, reaping; also for making canals, roads, and tunnels. It is a frame of iron, of 4 feet wide, and 20 feet long, with a shaft of seven feet long in front, and a shaft of 6 feet 6 inches long behind, with two broad wheels, and a steering wheel on the extreme end. On the front shaft are feet similar to spokes of wheels, with buffers on their extremities; these enter the ground by the revolving of the shaft. This is caused by a long lever of 20 feet swinging backwards and forwards on a spindle, and pulling alternately two levers of three feet in a box on two wheels, fixed to the shaft, similar to the capstan on the *Great Britain* steam-ship—with this difference, that the motion can be reversed, or the levers so placed, that they vibrate, without touching the driving-wheels. The power to work this machine is communicated by ropes, pulling alternately on the large lever; these ropes, at a distance of 100 yards, were wound around a double drum, and corresponding rope run from the drum to a distance of a further 120 yards, to two cranks of a steam engine. By this trial, a new mechanical principle was established—namely, the transmission of power from a fixed point to a moving point, going in arbitrary direction at the will of one man at the steering wheel, which was thought impossible by scientific engineers. By prolonging or shortening the communicating ropes, the distance from the prime mover to the machine travelling around its "satellite," can be from 20 yards to 1,600 yards in diameter. The ropes from the prime mover to the central drum travel upon pulleys and rollers to diminish friction, and from the drum to the "Satellite," they are held up by cars with poles, if they extend to a great distance, to keep them from the ground. The trial itself proved fully the practicability of the machine, and the applicability of the mode of transmitting power by levers and ropes from a fixed point to a moving point, although owing to some minor causes, such as smallness of some pulleys, and an oversight in the steering of the machine, it was not quite satisfactory to the general public who are used to see locomotives travelling at from 30 to 40 miles an hour. This machine is intended to work and move at a rate of three miles per hour, although the velocity with which it did go at this first trial has not quite realized that speed; but the shareholders of the society present, have expressed themselves satisfied: and at a meeting held by them in the evening at the Cross Keys Inn, have passed a vote of thanks to the engineer and his workmen for their skill and labour displayed in the construction of the machine. The trial was made on a square of eleven acres, on the property of Edward King, Esq., of Blackthorn, who kindly lent to the Tropical Emigration Society his steam carriage, which, eleven years ago, was running between Hammersmith and London. (This steam carriage has since become the property of the Tropical Emigration Society, in consequence of some arrangements between the former proprietor and themselves.) The steam carriage was fixed tightly on the ground, and on each of the large driving wheels was fixed a crank, on which a half-inch rope was fastened, communicating with the central drum. Two booths were erected on the ground, and many of the people of Bicester, Blackthorn, and the neighbourhood had a regular holiday.—*From a Correspondent.*

NOTES AND NOTICES.

Wager Boat.—A boat has been built for a rowing match at Liverpool, which measures 28 feet 4 inches in length, and weighs 42 lbs.; the material is mahogany, French polished.

The Atmospheric System is about to be applied in Portsmouth Dock-yard, to drive the saws in the wood mills.

Third Voyage of the "Great Britain."—Liverpool, Sept. 27.—The steam-ship *Great Britain*, Captain Hosken, left her moorings in the Mersey precisely at 4 o'clock this afternoon, and took her departure on her third trip across the Atlantic, with no less than 102 passengers—a proof that the prejudice once existing against her is fast disappearing before the proof of her capabilities, afforded by the successful result of her late voyage. She also carried out a large cargo of general merchandise. It may be interesting to mention that there was not the slightest fouling on the bottom of the *Great Britain* on her return from New York on Monday week.—*Bristol Mirror.*

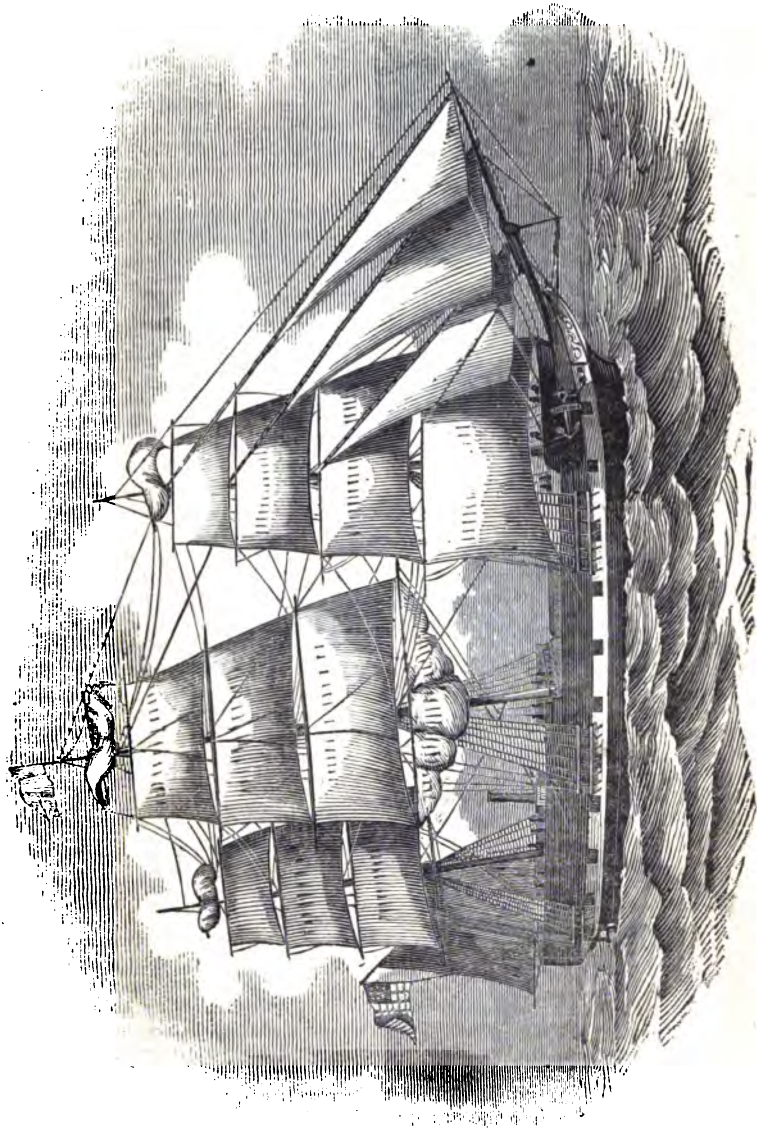
LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1158.] SATURDAY, OCTOBER 18, 1845. [Price 3*d*.

Edited by J. C. Robertson, No. 166, Fleet-street.



THE AUXILIARY STEAM PACKET-SHIP "MASSACHUSETTS."

THE AUXILIARY STEAM-PACKET SHIP "MASSACHUSETTS."

The arrival of this American vessel at Liverpool has excited the curiosity of all engaged in navigation. There are so many novelties combined in her, that some description of them will be interesting to the general reader, as well as to those who are engaged in Transatlantic navigation; therefore, I venture to ask for a place in your Magazine, for the following notes and facts, which, being derived from head quarters, are in every particular authentic. This account is the more necessary, as several articles of an inflated, and somewhat erroneous character have appeared in the Liverpool papers, which would be likely to elicit unfriendly criticism, although they were published with the best intention, and with the best feeling towards the *Massachusetts*. The letter signed by Colonel Perkins, published in the last number of your journal, is an exception to the above remarks, everything therein stated being true to the letter.

The *Massachusetts* is intended to run between New York and Liverpool, and is the first of a line which will be established as early as circumstances warrant. She is 161 feet on deck, 31·9 beam, 20 hold, and measures about 751 tons old style; she has a full poop, extending to, and including the main mast; under this are the accommodations for thirty-five passengers, fitted up in a neat, but plain and appropriate style, including shower baths and every convenience to make the passengers comfortable.

During the night powerful lights are kept continually burning on each bow, and these lights answer a double purpose. First in importance, each illumines a beautiful lens, showing a brilliant light, that may be seen from any vessel within the range of its reflection, at least three miles off in ordinary weather; and second, the same light, of course, illumines the sailors' quarters. Between the main and mizen masts, in one of the cabins, on each side, are lenses, the same as those forward, so that no vessel can approach her without seeing her lights from every point except her stern. This is an excellent arrangement, and one which I hope to see universally adopted. Its advantages to vessels engaged in the European trade are too obvious to require enumeration.

The poop and top gallant forecastle are connected by gangways 4 feet wide, which are on a line with the main rail, and these gangways have steps at each end by which the sailors ascend to the decks above, and *vice versâ*. The space under these gangways will answer well for water casks when she carries passengers, and is full below. The longboat, which is of a fine model, is stowed bottom up, about 4 feet above the deck, and rests on two cross pieces, which are supported by strong stanchions which pass through the deck below and are bolted to the beams. Alongside of the boat are places for the studding-sails, and under it are fowl coops, and pig and sheep pens.

The bow is very sharp and very beautiful. The angles formed by the cutwater and wood ends have been gradually filled up, which extends the lines of the ship to rabbets in the cutwater, and the cutwater itself is then fashioned to carry the sweep unbroken to a point. A slight concave, opposite the angles filled in, preserves the harmony of the lines and increases the sharpness of the bow. This filling in a false bow is entirely original. It increases the strength of the vessel forward, and causes less resistance to her speed, especially in a short head sea, and as it is carried up to the head, and decked over, it presents a smooth surface over which the broken water will roll as harmlessly as from the sides. Her bow is more upright and has less flare than other ships of her size, and is consequently stronger. The curve of her cutwater as it swells outward and forms the head is very easy and graceful. She has a neatly carved and gilded billet head, and carved work on the trail boards and around the hawse holes, and also a single carved and gilded profile of an Indian on the end of each cathead. Her sides have but little swell, but still they are very beautiful, and have been finished with the greatest care. Her run is extremely sharp, and although she has a full poop deck, which of course must increase the size of the stern, yet the latter is so finely fashioned and swells so handsomely outward as to appear comparatively light and easy. In her plankshear there are 84 composition ventilators, the tops of which can at all times be unscrewed when required. Be-

sides these she has ventilators similar to those in the Cunard steamers, which are made of copper, and operate like wind sails. Her bilge pumps, of which she has two, are also air-pumps, and, by rigging appropriate gear, the foul air in the hold can be easily pumped out. In case of accident, she is well supplied with boats; besides a large and beautiful long boat, fitted with masts and sails, she carries two excellent quarter boats and two life-boats. Every chair, stool and settee has tin air-tight apartments under them, so that in the event of a person falling overboard, one of these thrown to him would be a complete life-buoy.

She spreads the same quantity of canvass which she would have, if a sailing vessel alone, and she is modelled and equipped precisely as a sailing packet should be. She spreads the same surface of canvass as the *Paul Jones*, a ship of 680 tons, which ship has 2 feet more depth of hold, and a foot more beam than the *Massachusetts*, but is 15 feet less in length. A suit of the *Massachusetts* standing sails contains 3833 yards, each cloth 22 inches wide.

The rig however is new, and I believe it originated with the gentleman (R. B. Forbes, Esq.) under whose direction she was built. The peculiarities of it are, that all the masts are "fidded" abaft the lower mast head, that the lower mast heads are longer than usual, and that the sails are divided into smaller pieces. The dimensions of her spars are as follows:—

Masts.

	Diameter. Inch.	Length. Feet	inches.	Yard arms. Feet	in.
Foremast	23	78	11½	19	00
Fore topmast ...	13	42	00	5	00
Topgallant mast.	8½	15	00	00	00
Royal	00	11	6	00	00
Skysail	00	8	0	00	00
Mainmast......	26	83	06	20	00
Main topmast ..	13	46	00	6	00
Topgallant mast.	9	18	06	00	00
Royal mast	00	15	06	00	00
Skysail	00	11	00	00	00
Mizenmast	20	67	10½	17	00
Topmast	10	36	04	00	04
Topgallant mast.	6½	12	00	00	00
Royal..........	00	9	00	00	00
Skysail	00	6	00	00	00

Yards.

	Diameter. Inch.	Length. Feet	inches.	Yard arms. Feet	in.
Fore yard......	14	57	00	4	00
Lower topsail...	11	47	00	3	06
Upper topsail ..	8	36	06	2	06
Topgallant yard..	6	26	06	1	06
Royal	5	21	06	1	00
Main yard	16½	66	00	4	00
Lower topsail...	14	57	00	4	00
Upper	11	47	00	3	06
Topgallant	8	36	06	2	06
Royal	6	26	06	1	06
Cross-jack	11	47	00	3	06
Lower topsail ..	8	36	06	2	06
Upper	6	26	06	1	06
Topgallant	5	21	06	1	00
Royal yard	4	18	00	0	10

Her main skysail yard is of the same dimensions as the fore royal yard. The spanker boom is 45 feet long, and the gaff 34 feet, with 3½ feet end. Over the trestletrees of the lower mast heads, before and abaft the masts, are two strong iron bands, with eyes in them—and opposite the centre of the masts are two other iron bands, bent in over the trestletrees, and bolted to them. In the eyes of these bands are shackled the lower rigging. There are also iron bands around the heads of the lower masts, to which the stays are shackled. In other words, she has iron eyes to her lower rigging. Her topmast rigging is on the old plan, and sets up on its ends. Her topgallant, royal and skysail masts are all in one spar, and the eyes of her topgallant rigging are fitted around copper cylinders. This is for the purpose of keeping the rigging in its place when the masts are sent down or housed. She has chain bobstays, bowsprit shrouds, standing and flying martingale stays, and guys or back ropes; also chain topsail sheets and ties, iron futtock rigging, and patent trusses to the lower yards, and iron parrels to the topsail yards.

It will be seen by reference to the dimensions of her yards, that she has two sets of topsail yards. The first, named the lower topsail yards, set on the head of the lower mast, and the other, named the upper topsail yards, work on large iron rods, and the lower ends of which are secured into the left bands of the lower yards around the heads of the masts, and the upper end to the caps. The upper topsail, topgallant and royal

yards are parrelled around their respective masts. As a support to the lower mast heads there are two iron shrouds, one on each side, which lead outside of the top rims down abaft the futtock rigging, and set up to the iron bands around the masts. All her blocks have iron straps, covered with the wood of the shells, so that the hooks and beckets are the only parts of the straps which are visible, and the only parts which can chafe the rigging.

By again referring to the dimensions of the yards, it will be seen, that the head yards are of the same dimensions as those on the mainmast, commencing with lower maintopsail yard. That is, the lower maintopsail yard is the same size as the fore yard, and so on upwards, and the cross jack yard the same size as the lower foretopsail yard, and upwards in the same proportion. The yards and sails on the mizen mast, also fit on the main and fore, in higher positions than they occupy on the mizen.

In reference to this arrangement of the yards, to use the language of Mr. Forbes, the inventor of the new rig, "it will be readily perceived that by having a spare yard and sail on the mainmast, all the way up to and including the moonsail, she has a spare sail for all other places on the foremast and mizenmast, and, in case of necessity, the square sails on the last may be dispensed with, and used on other masts." Speaking of the advantages of the rig, Mr. Forbes says—

"One of the great advantages which I anticipate from this rig is, that the ship may be kept more steadily on her course than with the old rig, where it is very often necessary to luff and bear away a little to enable the men to reef or take in sail, or to prevent the large surfaces from being rent to ribbons; indeed, no one who has crossed the Atlantic to the westward in the winter months, can fail to be struck with the advantages in this respect as well as in the wear and tear. Some good seamen make it a general rule never to deviate from their course to make or to take in sail; they brace the yards 'by,' or put on extra force, and tear out the leeches; the ship's head way is lessened in either process, and some of the most dangerous seas ever shipped are the result of deadening the ship's headway too much in scudding before fresh gales while clewing down and bracing 'by,' to reef; in the present rig the ship may be kept under better command, until the time of close reefing arrives. In bending and unbending sails at sea, much labour and much time is saved; for, the sails being in small pieces, any one of them may be bent without materially stopping the ship's way; so, in case of the loss of a topmast, a new one may be got up in any ordinary bad weather, the doublings of the masts being so long, and in case of its being too rough to attempt it, the ship is still tolerably manageable, having double-reefed topsails to set. With this rig a ship may carry sail on a lee shore, or running for the land, or in squally weather, to great advantage. It not unfrequently happens that a ship is near the land with a quickly increasing gale, when to clew down her whole, or her single-reefed topsails, to reef them would render her situation in a great degree perilous, and the seaman is often obliged to carry or drag his sails and spars, when to carry is *safety*, and to drag them is almost *certain destruction*.

"In case of carrying away a lower yard, which, in the ordinary rig would subject the ship to great inconvenience, you have only to settle down all to the point where the lower topsail is, 'on the cap,' or to the lift band, and you may then work your ship tolerably well by boarding the topsail sheets as courses until the damage can be repaired. I beg you will understand me as recommending my rig *particularly* for the Atlantic trade, though I think its advantages are great for *any trade;* I would recommend it for ships whether they have *auxiliary steam power or not*. It is true, that to a ship having this additional aid it is more valuable than to another—for the obvious reason that all the top hamper may be quickly got down in order to combat against *ordinary head winds and tolerably smooth seas*, still leaving the ship (when topmasts are housed,) in a state to fill away under sails, equal to double reefed topsails and courses, jib and spanker; or in case of the ship becoming a little crank, by using up fuel, she may house her topgallant, or rather her royal masts in fresh breezes, without lowering the yard next below. The ease, too, with which reefs may be taken in and their efficiency when done is a great improve-

ment; in the old rig the reefs are often half-hauled out, and the sail is wearing out almost as fast as when set. The studding sails are also of manageable size, easily set and easily taken in. I have said enough of the rig to convince the reader that I entertain no doubt of the value of it.

"I have now enumerated the advantages of my rig, or some of them; I am not blind to the obvious disadvantages, which are—more yards, more blocks, more ropes, more corners and holes to let the wind escape, more weight aloft and more first cost. But these are partially obviated by having all these ropes, blocks, &c., lighter; the appearance is the greatest objection to my eye, and this would be a death blow to the rig with some seamen."

Such is the *Massachusetts* as a ship; we will now look at her as a steamer:—Her motive power consists of a condensing engine with two cylinders which work nearly at right angles, each 3 feet stroke and 26 inches diameter. There are two boilers, named "wagon boilers," each 14 feet long, 7 wide, and 9 high, with a furnace to each boiler. For the purpose of raising steam quickly, there is a blowing engine and blower; there is also a heater, on the same principle as that applied to the U. S. steam frigate *Princeton*. The blower is in the chimney, which passes through between decks, upper deck and poop deck, and is surrounded by a ventilating trunk as before described.

Her engine room is large, excellently ventilated, and every way protected against the contingency of fire. Its floor is of cast-iron. Her steam power is applied to an Ericsson propeller, the extreme diameter of which is 9½ feet. The shaft passes close to the stern post on the larboard side, and rests in a socket which is embedded and bolted to the stern post, and is further supported by a massive brace above. The propeller is made of wrought copper and composition metal, and can be raised out of the water when the steam power is not required.

The apparatus by which this is effected consists of a shaft which passes from the engine room through the stern, above and parallel to the shaft of the propeller. The mechanism of the upper shaft, when set in motion, revolves and raises the propeller out of the water and places it close against the flat of the stern, where it is secured with chains from either quarter. The whole process can be executed in a very few minutes. When this is done she is a complete sailing ship, in every particular.

The boilers are together 14 feet wide, and have ample space in the wings and under the forward end of them for coal bunkers, which can be approached either from the side of the ship or the between decks or engine room. She has a powerful hand pump and fire engine, which will be extremely useful for wetting the sails in light winds, washing decks, or extinguishing fire. The machinery was made by Messrs. Hogg and Co., of New York, agreeably to the plans and drawings of Captain Ericsson, of whose constructive ability as an engineer, it furnishes another honourable example.

A "shark's mouth," or opening is cut across the backing of the rudder, so that when the helm is put to starboard the rudder will traverse to port, clear of the shaft which extends beyond it. The force of both her engines is estimated at about 170 horse power, and 9 statute miles per hour, in smooth water, is the speed expected to be obtained by them, with a consumption of 8 tons of anthracite coals per nautical day.

The space occupied by the machinery and its appurtenances *in the lower hold* is 47 feet from the stern post forward, or one-seventh the cube of the whole ship.

The cost of her motive power is about two-sevenths of the cost of the ship herself. Her entire cost has been about 16,000*l.*

The voyage from New York to Liverpool was performed in 17½ days, during which time the *Massachusetts* experienced much variable weather, with a large proportion of head winds and rough tumbling swells, indicating more wind at the northward and eastward of her track Her steam worked admirably, and enabled her to arrive at her destination a week earlier than she would have done otherwise with the same winds; other vessels, pursuing a more northerly course, had a much better course of winds; the *Caledonian*, which sailed the day after her from Boston, particularly had a great proportion of westerly winds and no calms and head winds. The speed attained in still water was nine statute miles; and several times seven and

eight against moderate head winds, all sails being furled, and all the masts and yards aloft. During the passage no opportunity offered to try the steam against strong breezes; it is not expected, however, that the small power of a 9½ feet propeller can do much against very strong breezes when not aided by the canvass. The propeller can be usefully appropriated, however, in sailing very close hauled (say 5½ points) and making as much progress under such circumstances as the fastest sailing vessel makes within 7 points of the wind.

The *Massachusetts* is intended as the pioneer of a regular line of *steam-packet* ships between Liverpool and New York. To quote Mr. Forbes again, however; "let it be distinctly understood that we do not call her a steamer, or expect her to make steamboat speed, *except under canvass;* her steam power is *strictly auxiliary* to her canvass, and is intended, *as a general rule,* to be used only in calms or against moderate head winds; *occasionally* when near the land and in tolerably smooth water it may be very valuable in getting speedily into port, even against fresh breezes, by housing her topmasts and putting her head to wind, or while beating under canvass; it will also be of service in getting in and out of port, in keeping off a lee shore, and in making the ship comparatively safe when at anchor in any exposed situation."

She is expected to make five complete voyages per annum, making her passages in an average of 18 days, summer and winter. Captain A. H. White, an experienced and energetic sailor, commands her. She proceeds on the 18th instant, for New York, whence she will sail on the 20th November for Liverpool.

No one can view this ship, even casually, without being impressed with the vast amount of thought and labour which must have been applied to produce such an harmonious whole. Whatever may be her success, Mr. R. B. Forbes, her designer, is entitled to great praise for his ingenuity and industry. She is an original, yet complete in every detail, and beautiful as a whole.

E. N.

Liverpool, October 10, 1845.

ON THE WORKING OF STEAM EXPANSIVELY IN THE ROYAL STEAM NAVY.

Sir,—I was much pleased to observe, some time ago, in an editorial note in your journal, (vol. xlii., p. 406), a well-deserved compliment paid to Commander Hoseason for his exertions in awakening the Admiralty to a due sense of the advantages of working steam expansively, and in spreading a knowledge of them amongst his professional brethren. It must be confessed, however, that there is still a lamentable degree of ignorance prevailing among Royal Navy men on the subject. Talk to any one of them about it, and the chances are ten to one he will observe, "Oh, I know all about it; it 's the throttling of the valve, you mean—very clever invention that!" Which is just as much to the purpose, as if a man were to tell you that the best way to expand your chest, is to pull your stock or cravat, tighter. It would contribute, I think, materially to the diffusion of juster notions were you to publish the pith and substance of those letters in which Mr. Hoseason first drew the attention of our naval authorities to the subject, copies of which I now send you. They were printed afterwards, but for private distribution only, and there are yet many who have never seen or heard of them. The first is dated 22nd March, 1841, and addressed to Sir Wm. Parker, then one of the Lords of the Admiralty; the second is dated 15th Sept. 1841, and was written to another distinguished officer (though not in office) Admiral Sir Graham Hammond. These letters present a lively picture of the course of inquiry and reflection by which a person of strong and intelligent mind—himself originally as innocent as his fellows of knowing what using steam expansively meant—arrived at distinct and clear views both of the theory and practice of the affair; and they will not perhaps be read with the less pleasure by naval men that they are written by one of themselves, and much after a manner of which they are themselves the especial patrons—that is to say, in a style called by the learned, the diffuse, but by plain speaking Jack, the *long-yarn.* I remain, sir, your constant reader,

BINNACLE.

Plymouth, 11th Sept., 1845.

[We feel much obliged to our correspondent "Binnacle" for enabling us to lay some extracts from the clever letters referred to before our readers. We

must say, however, that we do not recognize the diffuseness at which he hints; everything appears to us very much to the point.—Ed. M. M.]

From letter by Mr. Horeason to Admiral Sir William Parker.

"It is now some years since, when dining at your table on board the *Asia*, in the Tagus, that I listened to a conversation addressed to you by Capt. Robt. Oliver, who had that afternoon arrived (if my memory serves me right) in the *Phœnix*. In speaking of the qualities of his vessel, he remarked, as a singular fact, that with half the consumption of coal, he could obtain better than two-thirds of the velocity; for instance he said, 'Sir William, with all my fires lighted, I can only generate steam sufficient to give a velocity of nine knots; but with half that consumption of fuel, I can generate steam that will give seven.' This was a fact which I took upon trust, as coming from such a quarter, though I could not sufficiently account for it. Subsequently, however, on joining the *Excellent*, in the course of my reading I met with a paragraph in 'Arnott's Physics,' or 'Lardner's Lectures on Steam,' which fully explained the matter; the paragraph ran in substance to this effect, 'that as the resistance of bodies passing through fluids, was as the square of their velocities, it would be highly desirable for naval officers to be acquainted with such fact, as they would then know when to economize their fuel; for a speed of seven miles an hour, would oftentimes be sufficient for the exigencies of the service, and that that velocity could be obtained by the reduction of the fuel of one half.' You will perceive, Sir, how clearly this agrees with Captain Oliver's fact; for the square of 7 is 49; but the square of 9 is 81, which is nearly double.

"This subject, which I hope I have now sufficiently explained, involves in itself, I cannot help conceiving, a paradox, 'for it is both known and not known;' known to some individuals who may have brought it occasionally into play, but not known sufficiently for the service to derive any benefit from it. What, then, I propose is this,—that whenever a steamer is despatched on any service, the Admiral shall inform the Commander what speed will answer all purposes of the service. Of course the speed of steamers will vary as to their properties in construction; but it will not be difficult for the Captains to obtain the relative velocities of the vessels under their command. I need not enter into any computations to prove the immense saving that will certainly follow the enforcing a strict attention to this subject; admitting what I have said to be correct.

"A strong case* in support of my argument has lately occurred; and it is this case which has induced me to bring the subject under your notice for consideration. The *Stromboli* received orders from Sir John Ommanney to sail for Acre, and take on board some officers and men that had been left there. She was then to proceed to Beirout; and after having supplied the *Hecate* with what coals she could spare, was to go direct to Malta with her passengers. By some accident, she did not reserve for her own use sufficient coal; and consequently, when a hundred miles to the westward of Candia, meeting with a strong westerly wind, she bore up for this port, but I presume they discovered the mistake they had made shortly after their departure from Beirout; and had they but husbanded their fuel as above mentioned, I have not a doubt on my mind, they would have steamed to Malta with ease. The loss of time is not the only thing to be considered, for she deprived this port of coals that could ill be spared. I shall not burthen you with a repetition of arguments, which seem to me to carry conviction on the very face of them; but I wish to remind you, Sir, I am not reasoning *up* to a fact, but *back* to one.

"Having drawn up this statement, I submitted it for the consideration of Captain Warden of the *Medea*, and asked him if he considered my reasoning conclusive. He replied, he would furnish me with rather a strong fact in the support of my semi-theory; it was this, 'that, not wishing to make Malta too early, he directed them to shut off half the steam; but yet the vessel suffered a very trifling diminution of speed.'† I beg also to point out that the saving of the

"* In the body of this letter I have asserted the *Stromboli* did not adopt what I recommend; but I do not give it as an unquestionable fact. My reason for believing so is that I have never heard of its being *systematically* practised; if she has brought it into play she may be an exception to prove my rule; however, an inspection of her logs will show. The *Vesuvius* could not fetch Malta, gave her mails to a French steamer, and was herself towed in two days after by the *Great Liverpool*. I wish I had the particulars of her case.

"I trust in charity to me that nothing I have brought forward to substantiate my position will be allowed to militate against any individual."

"† I have stated she shut off half the steam, as that is the only proper way for it to be expressed. Half speed is a misnomer, and from this misnomer much error may be deduced, a double velocity requires four times the power. For example, the square of the 5 is 25, but the square of 10 is 100; he, then, that would diminish the velocity by one half, must shut off three-fourths of the steam, or never cause it to be generated, which comes to the same thing. When you read in the papers that two vessels came in collision going half-speed, you read what is incorrect."

boilers would also be of vital importance, as the fires could be used alternately."

From letter by Mr. Hoseason to Admiral Sir Graham Hammond, dated H.M.S. "Cambridge," Beirout, September 15, 1841.

"When the fleet were ordered out to leave Marmorice and rendezvous at Malta, Sir John Ommanney dispatched us to Suda (in Candia) with certain orders, and we were afterwards to proceed to Malta, with as little delay as possible; on arriving at Suda we found lying there the *Hydra* steam vessel. Captain Murray was on shore; consequently the First Lieutenant came on board to wait on Captain Barnard; this Lieutenant in the course of conversation with Captain Parker, our commander, stated, that the Commander-in-Chief had desired them to husband their fuel by every means in their power; this was taken as a hint that he did not relish the idea of towing us out, as the wind was then dead in. As soon as he was gone, I remarked to Captain Parkin that, however peremptory these orders might be, they would not be complied with; as I was confident the *Hydra* would steam to Malta with full power, whatever might be the state of the weather. My assertion was justified by the fact that they arrived at Malta before we obtained pratique, having performed the distance in two days and four hours, at an average velocity of ten knots an hour; and as my informant (the first Lieutenant) stated they having enjoyed most beautiful weather, there not being a breath in the heavens to cause even a ripple on the water. Now by my plan she would have done the distance in 65 instead of 52 hours, expending 32½ in lieu of 52 tons of coals, working two boilers for 65 hours, instead of four boilers for 52 hours, which is the proportion of 130 to 208: the mischief done to the engine by a higher velocity I cannot estimate, but some idea may be formed from the increased consumption of oil and grease, as well as another reason I will presently assign. The value of coals at this period to Government was 2*l.* 15*s.* per ton.

"Captain Parkin dining in company with Captain Murray, after we obtained pratique, mentioned to him my proposition, and asked if he would try it on his passage to the West Indies; Captain Murray replied 'No, I shall steam with full power till I get into the trades, and then sail.' Being informed of this, I expressed my regret to Captain Murray, that he, an old shipmate and friend of mine in the *Excellent*, should reject at once my theory without giving it a trial; as he was not tied to time, and consequently would never have a more favourable opportunity. Captain Murray then said 'What is your theory? I don't understand you.' 'Indeed!' I rejoined, 'so you do not understand me. Do you then reject propositions on the instant without understanding them?" Upon this I explained what I have stated above; and was told by Captain Murray, that I was opposed to the axiom, 'the greater the velocity, the greater the saving of fuel,' and that the latter truth had long received ample demonstration. This, though it did not serve to convince me, clearly proved that I was opposed by no mean authority, and naturally created in me great anxiety to discover who the authority was, and on what facts the reasoning was based.

"Breakfasting with Captain Austin of the *Cyclops*, a few days subsequent to the above conversation, and reading to him my letter to Sir William, he rose to show me in Tredgold's voluminous work the action of some part of the engine; chance directed my eyes to a paragraph which distinctly denied the law of the squares as applicable to steamers.

"Not liking to borrow so valuable a work for the time requisite to make myself acquainted with his reasons for arriving at this conclusion; I put my hand on all the works on steam that I could with decency press into my service, taking it for granted one or the other would throw some light on the subject; and in Lardner's edition 6, page 313, I found what I so anxiously sought; the quotation I shall give verbatim, as it is too important to curtail, and I trust I shall be able to show that

> 'Such reasoning falls like an inverted cone,
> Wanting its proper base to stand upon.'

"'In considering the general economy of fuel, it may be right to state, that the result of experience obtained in the steam navigation of our channels, and particularly in the case of the Post-office Packets on the Liverpool station, has clearly established the fact, that, by increasing the ratio of the power to the tonnage, an actual saving of fuel in a given distance is effected, while at the same time the speed of the vessel is increased. In the case of the Post-office steamers, called the *Dolphin* and *Thetis* (Liverpool station) the power has been successively increased, and the speed considerably augmented, but the consumption of fuel per mile has been diminished. This at first view seems inconsistent with the known theory of the resistance of solids moving through fluids; since this resistance increases in the same proportion as the square of the speed. But this physical principle is founded on the supposition that the immersed part of the floating body remains the same. Now I have myself proved by experiments on canals, that when the speed of the boat is increased beyond a certain limit, its draught of water is rapidly diminished; and in the case of a large steam

raft constructed upon the river Hudson, it was found, that when the speed was raised to 20 miles an hour, the draught of water was diminished by 7 inches. I have therefore no doubt that the increased speed of steamers is attended with a like effect, that in fact they rise out of the water; so that although the resistance is increased by reason of their increased speed, it is diminished in a still greater proportion by reason of their diminished immersions.

"'Meanwhile, whatever be the cause, it is quite certain that the resistance in moving through the water must be diminished; because the moving power is always in proportion to the quantity of coals consumed, and at the same time in the proportion to the resistance overcome. Since the quantity of coals consumed in a given distance is diminished, while the speed is increased, the resistance encountered throughout the same distance must be proportionally diminished.'

"Now as the Doctor has not furnished me with the particulars of his own experiments, I am not able to meet him as I should wish; but it is otherwise with the instance cited on the river Hudson: there I deny the propriety of the reasoning by analogy. Let me state the particulars of the case: A raft constructed with two metallic tubes in the shape of a cigar, each 300 feet long, was propelled by a high-pressure engine, having wheels 30 feet in diameter; this raft at its greatest displacement only drew 30 inches water, and when a velocity was obtained of 20 miles an hour, was said to have risen 7 inches.

"But surely, by the most sanguine, this small decrease of immersion cannot be expected from the *Great Western*, (which steamer supplies one with the nearest comparison with regard to power used) much less the relative proportion in feet. The *Great Western's* maximum velocity, under the most favourable circumstances, is but 12 miles an hour, and is not propelled with high-pressure engines, but she has wheels of 30 feet in diameter (the same as the raft) draws 16 feet, and measures 1340 tons, with a length of 212 feet. Does not the mere statement of the case carry with it its own refutation? But, suppose there be a person found that will hold with the reasoning of the Doctor; I can then fairly plead an arrest of judgment; for no *one* effect can arise from *two* causes, which two causes are diametrically opposed to each other. 'H. M. steam vessel *Columbia*, to wit, had originally a pair of 60-horse engines which were exchanged for two 50's; after which she went faster and consumed less coals.'—*Otway on Steam*, p. 170.

"These contradictions I take it cannot be reconciled on the principles laid down by the Doctor; but I will not try my hand at them. This fact has been lost sight of by Doctor Lardner, as well as by many others, that to work engines of considerably increased power a very small addition of fuel is required; but, if the vessel has been previously underpowered, a great increase of velocity will be obtained. To prove the truth of this I have only to state that most of the large class steamers in the Mediterranean, though differing materially in tonnage and horse-power, and even in velocity, consume on an average a ton of coals an hour; and the *Great Liverpool*, only expends one-seventh more fuel than the *Medea*, though her horse-power is as 450 to 220; this I trust will account for the Doctor's case: now for Captain Otway's, 'The *Columbia floated lighter*, went faster, and consumed less coal," these are the Captain's own words, those with a dash under them I suppressed in my first quotation.

"Even the power may be increased by a better adaptation of cylinders to boilers; which is curiously explained by Otway, page 172, in the term '*working up*,' the following is the quotation.

(*To be continued in our next.*)

ON THE ANTHRACITE AND BITUMINOUS COAL FIELDS OF CHINA; THE SYSTEM OF MINING, AND THE PRICES OF COAL, AND LABOUR IN ITS PRODUCTION, AND TRANSPORTATION TO PEKIN. BY RICHARD C. TAYLOR, PHILADELPHIA.

We have seen the recent announcement of the sailing of a vessel containing 308 tons of Pennsylvania anthracite, destined for Hong-Kong, in China. Some very natural speculations have arisen from this circumstance, as to the probability of that country furnishing a market for American anthracite. As no details accompany the statement alluded to, we are not in possession of any material facts whereby an estimate can be formed of the probable success of the undertaking, in a commercial sense; and we are not sure but the coal may have been employed for convenience merely, as ballast.

In the East Indies various depôts of European coal have been established, for the service of the British government steamers. This fuel, for the most part, it is understood, consists of the anthracitous and partially bituminous coals of South Wales, of course obtained at great expense. It appears that 5000 tons of English coal, at a freightage of £2 per ton, are annually imported into Bombay, for the Company's

steamers. Bituminous coals have been derived from much less distant sources; among which the Burdwan coal field, in the vicinity of Calcutta, may be named. Mergui Island, also, in the Bay of Bengal, has lately furnished some steam coal to Singapore. The steam ships on the China seas, during the war with that vast country, were supplied from these various sources.

I do not propose to discuss the profitableness, or otherwise, of a Chinese market for our American anthracite. But as during the process of collecting statistical information for a proposed volume on "the geological and geographical distribution of coal and other mineral combustibles," some notes reached me, of an interesting character, which are not generally accessible to the majority of readers, with relation to the Chinese coal fields, it has struck me that a portion of these details, in an abridged form, might be just now acceptable, particularly as the intercourse with that country is on the increase. I venture even to omit, for the present, the authorities for the facts I shall have to communicate; reserving them in detail for the volume adverted to. It must, nevertheless, be premised that to the Jesuit Fathers, the French Missionaries, who were permitted to reside at Pekin during the 18th and preceding centuries, we are indebted for details of the highest interest, not alone on this subject, but on many other objects of philosophical inquiry in that little-known region.

It is probable that coal was discovered, and was in common use in China, long before it was known in the western world. It is mentioned by a noble traveller of the 13th century, as abounding throughout the whole province of Cathay, of which Pekin is the capital, "where certain black stones are dug out of the mountains, which stones burn when kindled, and keep alive for a long time, and are used by many persons, notwithstanding the abundance of wood."

The good missionaries were fully capable of describing the coals which were supplied to Pekin, since they there erected a furnace or stove, in which they experimented on the properties of those combustibles; particularly with reference to the ordinary domestic uses, and for the warming of apartments and the purposes of their laboratory.

Among the people of Pekin, three kinds are in use.

1. That employed by the blacksmiths. It yields more flame than the other qualities; is more fierce, but is subject to decrepitate in the fire; on which account, probably, the blacksmiths use it pounded in minute particles.

2. A harder and stronger coal used for culinary purposes, giving out more flame than the other sorts so employed; it is less quickly consumed, and leaves a residuum of gray ashes. There are several gradations of these. The best are hard to break, of a fine grain, a deep black colour, soiling the hands less than the others. It sometimes is sufficiently siliceous to give fire with steel. Others have a very coarse grain, are easily broken, and make a bright fire, leaving a reddish ash. Another species crackles, or decrepitates, when first placed on the fire; and falls down, almost entirely, in scales, which close the passage of the air, and stifle the fire.

3. A soft, feebly burning coal, giving out less heat than the second class; consuming more quickly, it breaks with greater facility, and in general is of deeper black than the sorts previously mentioned. It is commonly this description, which, being mixed with coal dust and a fourth part of clay, is employed to form an artificial and economical fuel. This being moulded in the form of bricks and balls are sold in the shops of Pekin. Wagon loads of coal dust are brought to that city for this sole purpose.

The coal merchants have also an intermediate quality, between the classes two and three.

We cannot, in this place, recite the numerous details which are furnished by these intelligent Fathers. Suffice it to add, that nearly the whole of the properties and applications are now in every-day use in the United States, and are familiar to all. They are, in fact, the natural results suggested by qualities possessed in common by the combustibles of remote parts of the same globe. Even the modern method of warming all the apartments of our dwellings, which we view as the result of superior practical and scientific investigation, was in use with very little deviation, centuries ago, by the Chinese. Many a patented artificial fuel compound both in Europe and America, has been in practical operation in China, at least a thousand years.

4. Anthracite.—Another description of coal abounding about thirty leagues from Pekin, but which was not then in such general use there as the other kinds, is called by the Chinese Che-tan. Che means a stone, but tan is the name they give to wood charcoal. Therefore, according to the genius of the Chinese language, this compound word signifies a substance resembling or having the common properties of stone and charcoal. There can be little difficulty here, in recognising the variety of coal which, in our day, has been denominated anthracite, a compound word of similar meaning.

The Chinese *glance coal* forms a remarkable exception to the unfavourable conclusion prevailing against Oriental coal; and, according to more recent authority than those we before cited, deserves to rank at the head of the list, in respect of its purity as a coke; although, in specific gravity, it does not come up to the character of the Pennsylvania or Welsh fuel; neither has it the spongy texture which contributes much to the glowing combustion of the latter.

So late as 1840, a Russian officer has described the coal formations of the interior, as occupying the western mountain range of China, in such abundance that a space of half a league cannot be traversed without meeting with rich strata. The art of mining is yet in its infancy among the Chinese; notwithstanding which, coal is thought to be at a moderate price in the capital. Anthracite occurs in the western range of mountains at about a day's journey, or about thirty miles, only from Pekin. The coal formation is largely developed, in which thick beds of coal occur. They appear to be of various qualities. Some of this coal, occurring in shale beds, is singularly decomposed, and its particles have so little cohesion, that they are almost reduced to a state of powder. Beneath these coal shales are beds of ferruginous sandstone, and below those occur another series, consisting of much richer seams of coal than the upper group.

In this range are seen also both horizontal and vertical beds of conglomerate, accompanied by seams of coal, which have the conglomerate for the roof, and diorite or greenstone for the floor. As might be expected, this coal very much resembles anthracite. It is shining, of compact texture, difficult to ignite, does not flame in burning, or give out any smoke. Its substance is entirely homogeneous. Every thing respecting it, leads to the belief that there had been a great development of heat at the period of its formation, or subsequently. The horizontal coal beds are the most important and valuable, and are denominated large; but no greater thickness than three and a half feet is quoted. The blacksmiths and those who work in copper, prefer this coal, on account of the intense heat which it gives out.

Throughout the whole of this mountain range may be continually seen the outcrops of this combustible, where they have never, as yet, been touched by the hand of man.

In those parts of China where wood is very dear, coal is worked on a great scale for the Pekin market; but the process of mining is very little understood by those people, who excel in the preparation of charcoal.

Coal in other parts of China.—The Missionaries and others inform us that coal is so abundant in every province of China that there is, perhaps, no country of the world in which it is so common. The quays at Nankin are stored with the finest native coal. Some of the coal which was brought down to the coast, from the Pekin country, to the Gulf of Pe-tchee-lee, was anthracite, partaking of the character of plumbago or graphite. Coal, apparently of the brown coal species, exists extensively in the direction of Canton; while all the coals seen on the Yang-tse-kiang river, south of Nankin, resembled cannel coal. Nearer to Canton it possessed the comparatively modern character of brown coal. It was abundantly offered for sale in the different cities through which Lord Amherst's embassy passed, between Lake Po-yang-how and Canton, and the boats were largely supplied with it. It is there obtained by means of pits, like wells; and we infer that, like nearly all the brown coal deposites, the beds were horizontal, and at no great depth. A sulphurous coal, interstratified with slate, and in the vicinity of red sandstone, also prevails towards Canton.

Thus, therefore, we possess evidence, the main object which this communication was designed to exhibit, that extending over large areas in China, are beds of tertiary or brown coal, of cannel coal, a dozen varieties of bituminous coal, of anthracite, glance coal, and graphitic anthracite; all of which, for ages, have been in common use in this remarkable country; and have been there employed for every domestic purpose known to civilized nations of all times; including gas lighting, and the manufacture of iron, copper, and other metals.

Mode of Mining Coal in China.—It might be expected that in China, where most of the practical arts have, from time immemorial, been carried on with all the perseverance of that industrious people, the operations of mining coal would be conducted with some regard to science, in relation to sinking, draining, and extraction. We have, however, good authority, especially in regard to the environs of Pekin, for stating that the process is still in a very imperfect state. Machinery there to lighten labour is unknown. They have not even an idea of the pumps indispensable to draw off the water. If local circumstances allow, they cut drainage galleries; if not, they abandon the work whenever the inundation has gained too far upon them. The mattock and shovel, the pick and the hammer, are the mining instruments—the only ones, in fact, which the Chinese employ in working the coal. The water of the mine is emptied by the slow

process of filling small casks, which are brought up to the surface by manual labour. Vertical shafts are not used. In working horizontal coal seams, the timber is expensive, and the materials cost 2 copecs per pound, = 8 dollars 50 cents per ton, English wood being sold by weight in China.

The coal, when mined, is put into baskets, and drawn upon sledges, which are raised to the surface by manual strength. Each basket contains about three pounds of coal, and one man can raise about eight baskets in a day. This is equivalent to 1032 Russian pounds, or to 12 cwt. English, per day. The miners' wages are at the rate of 30 copecs a basket; which is equal to 240 copecs (copper currency), or 46 cents of United States currency, per day; being 76 cents U.S., per ton.

Prices at Pekin.—At the pit's mouth, this coal is sold for 60 copecs per pound, = 4 dollars 63 cents per ton of 20 cwt. It is then conveyed on the backs of mules through the mountains, and thence on camels to Pekin, where the price is 1½ rouble, = 1½ francs, = 29 cents United States per pound; which, if our calculation be correct, is equal to 11 dollars 60 cents United States, or 2*l.* 8*s.* 3*d.* per ton of 2240 pounds English. We perceive, therefore, that the best of fuel is expensive at Pekin, and hence the necessity for resorting to the artificial compounds and substitutes to which we briefly alluded.

There is, however, a kind of coal sold in that city at a much lower price, particularly when it is mixed with one-half of coal dust. This coal, in 1840, sold for one rouble per pound, which is at the rate of 7 dollars 75 cents, = 1*l.* 12*s.* 3*d.* per ton. It is of indifferent quality, however; giving out but little heat, and is quickly consumed.

The compound fuel, consisting of coal dust and clay, is still prepared after the mode described by the missionaries last century; but its use is chiefly confined to the indigent classes.

Coal Gas Lighting in China.—Whether, or to what extent, the Chinese artificially produce illuminating gas from bituminous coal, we are uncertain. But it is a fact that spontaneous jets of gas, derived from boring into coal beds, have for centuries been burning, and turned to that and other economical purposes. If the Chinese are not manufacturers, they are, nevertheless, gas consumers and employers, on a large scale; and have evidently been so, ages before the knowledge of its application was acquired by Europeans. Beds of coal are frequently pierced by the borers for salt water; and the inflammable gas is forced up in jets, twenty or thirty feet in height. From these fountains the vapour has been conveyed to the salt works in pipes, and there used for the boiling and evaporation of the salt: other tubes convey the gas intended for lighting the streets and the larger apartments and kitchens. As there is still more gas than is required, the excess is conducted beyond the limits of the saltworks, and there forms separate chimneys or columns of flame.

One cannot but be struck with the singular counterpart of this employment of natural gas, which may be daily witnessed in the valley of the Kanawha, in Virginia. The geological origin; the means of supply; the application to all the processes of manufacturing salt, and of the appropriation of the surplus for the purposes of illumination, are remarkably alike, at such distant points as China and the United States. Those who have read, even within the present month, the account of the recent extraordinary additional supply of gas, and the services it is made to perform at the Kanawha saltworks, must be impressed with the coincidence of all the circumstances with those which are very briefly stated in the previous paragraph, in relation to China. In fact the parallel is complete.

To the coals and combustible minerals of China, I cannot further advert here. But what a conviction irresistibly presses upon the mind, as to the incalculable utility of the *railroad system*, and coal mining improvements in such an empire! If ever there were concentrated at one point all the circumstances especially and unequivocally favourable to that system, and imperiously calling for improvements of the character suggested, it seems to be presented in the case of the city of Pekin. Here, with its enormous population of 1,500,000 souls, it is situated only at a day's journey—computed at thirty miles—from an immense region of coal, comprising several varieties. Yet its inhabitants cannot purchase the best qualities of this coal, brought from the mountains on the backs of mules and camels, under 11 dollars 60 cents per ton, and the very worst for less than 7 dollars 75 cents per ton.

Without making unnecessary or invidious comparisons, it might not unreasonably be suggested, that a Pekin railroad, in connexion with the coal mines, would be a far more profitable enterprise in its results, than the transportation of American coals to China.

I will only add one circumstance, which had nearly escaped me. Borneo, "the largest island in the world," which is only twenty degrees due south of Canton, has lately come into repute for the great quantity of coal which it contains, not only accessible to ships along the coast, but extensively occurring in the mountains of the interior.

Much information has also been acquired from the natives; and the facts which are already elicited are regarded as of considerable importance, in respect to the facilitating the steam navigation of the China seas.

Philadelphia will, of course, have her share in the enlarged commercial intercourse with China. Would it, then, be asking too much of those who are personally interested in this improving trade, to communicate any additional facts which are either unknown to, or have been omitted by, the author of these scanty notes?

Philadelphia, April 28th, 1845.

[NOTE.—The prices and admeasurements, which are quoted in the foregoing article, were reduced to the United States and English currencies and measures, from the Russian, as furnished by the engineer Kovanko; who, in like manner converted them into the Russian from the Chinese standards. In consequence of this triple conversion of standards, additional care has been taken to avoid error in these calculations.]—*Franklin Journal.*

A MODE OF TANNING LEATHER BY MEANS OF A FLAGELLATOR.

The Committee on Science and Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a mode of tanning leather by means of a flagellator, patented in June, 1844, by Robert Downey, New Albany, Floyd County, Indiana, Report:—

That the object of the invention is to diminish the length of time required in tanning, an object which has been kept in view of tanners during the last half century of general improvement in the arts, as witnessed by the almost numberless patents issued in various parts of Europe and the United States, during the time specified. These attempts have been successful to a very limited extent, since the general experience has been that in proportion as the time is diminished, the quality of the tanned leather is injured, or, up to a certain point, the quality is inversely as the time employed in tanning. Nevertheless, at the present time, it would be wrong to assert that a more rapid process, compatible with quality, cannot be devised.

Mr. Downey proposes *flagellation*, as the means of diminishing the time, on the assumed principle that the pores of the hide are closed in the ordinary tanning process, preventing thereby the entrance of the bark liquor. By flagellation with a machine, he believes that the hide is raised and thickened, the pores opened, and while the gelatin and gluten are oozing out, the bark liquor is driven in.

Without farther noticing the mistake in confounding gelatin and gluten, we observe two principles assumed: 1. "the closing of the pores by bark or its infusion;" 2. "the oozing out of gelatin."

1. The committee cannot agree with the proposition that the pores of the hide are closed, certainly not closed in such a manner as to prevent the solution of tannin from entering into them, and they confidently believe that all experience shows that the pores are open and remain so; for the length of time required in the ordinary process cannot possibly be ascribed to the extreme slowness of infiltration through closed pores. Where hides are suffered to remain too long in the *handler*, or on a *layer*, especially during the warm season, without renewing the supply of fresh bark, a species of fermentation produces a mucilaginous or slimy coating, which closes the pores more or less effectually, and this may be viewed as the only case in which a closing of the pores takes place.

2. The "oozing out of gelatin" is erroneous; for the practical tanner knows of no case of the loss of gelatin by mechanical means, and it may be shown to be impossible on chemical grounds. The gelatin does not exist ready formed in the hide, but by the action of hot water the tissues are transformed into gelatin, and the same takes place slowly during the operation of tanning, lapse of time with the conjoint action of tannin in solution performing the transformation which heat effects rapidly. But on the other hand, admitting the proposition to be true that flagellation presses out gelatin, the tanner can show that it would be positively injurious; for the leather would not exhibit that increase in weight which it is his aim to produce, not merely for the increased profits due to the greater number of pounds, but because this increase in weight increases the firmness and durability of the leather. Gelatin combines with a certain proportional quantity of tannin constituting leather; hence, when a portion of the former is lost, there is nothing to replace it, for the remaining gelatin will only take up its due proportion of tannin and no more, and all other matter added to restore the lost weight would be mechanically intermingled or lodged in the leather, while nothing can compensate for the loss of firmness and durability.

The committee would state that no samples of leather having been offered them prepared by Downey's process, they have judged of the value of the process on general principles.

By order of the Committee,

WM. HAMILTON, Actuary.

—*Journal of the Franklin Institute.*

THE PADDLE-WHEEL AND SCREW—FURTHER EXPERIMENTS WITH HER M.M.S. "BEE."

[Extracts of letters from an Officer at the Royal Naval College, Portsmouth.]

We have had a capital experiment to-day (6th Oct.) with *Bee*, Paddle *versus* Screw. I must tell you, however, that the screw sent from Woolwich yard for *Bee*, instead of being a left-handed one, was a right-handed one, and luckily it was so (not for screw advocates) for it enabled us to make a very pretty experiment, which was the following. I should have told you, first of all, that the *Bee* being fitted with paddle and screw, it is requisite to have a screw that goes the opposite way to the paddles. When I say opposite way, I mean one shaft to revolve with the sun, and the other against it; this arises from the mode of application. The experiment was this,—the paddle and screw were thrown into gear at one time, the paddles going the head way, and of course, the screw the back way. The paddles walked off with the screw in good style. An objection was started, that the screw was working in the broken water of the paddles. They then reversed the engine, going the back way with wheels, head way with screw. *The result was the same*,—paddles again walking off with the screw. Look at this, sir,—a more beautiful experiment never could be; here you had the same steam, revolutions, &c.; in fact, nothing could be better,—the circumstances perfectly the same in all respects. Not as when *Rattler* took *Alecto* in tow; the odds were against *Alecto*, her revolutions being about 9 per minute, *Rattler* 22 or 23, (about that); more steam—more power. After the above experiment, they hooked *Bee* on to dynamometer, paddles and screw working one against the other. The paddles overcame the efforts of the screw by 317·16 lbs. Now, let me tell you, sir, that the direct pull of *Bee* by dynamometer with paddles alone, is 627 lbs., screw 583 lbs. Look here at the proportion that 317·16 lbs. bears to this. Is it not evident that we might work "expansively" with paddle and beat the screw?

It was a pretty sight to see the struggle for the championship. We tried also to-day, the screw with fuel, &c., &c., with steam maintained at 5 lbs. to ensure more blowing off—having done the same with paddles. The fuel consumed in 2 hours was 205 lbs.; revolutions 26 per minute; pressure by dynamometer, 48 lb. $\times$ 11 = 528 lbs. With paddles under the same circumstances precisely, but pressure 53 $\times$ 11 = 583 lbs., and revolutions per minute, 16; the fuel consumed was 140 lbs. in the same time, viz., 2 hours.

It may be said the *Bee* is not a good specimen of a screw boat; neither is she a paddle boat, for the slip of wheel is too great; it is a large wheel, over a short crank: that is, the paddle arm should be less, with a broader paddle float, so that the slip might be reduced.

* * * *

When the pressure of 317 lbs. was obtained by the paddle over the screw, the speed of the engine was only 14 revolutions per minute, but when the pressure of 583 lbs. was given off, the revolutions of engine were 28; this is double, you will perceive; but when working both together, the screw, of course, could only revolve with the paddle, that is, it had its multiple 4 to 1, the screw itself making 56 revolutions, and when the paddles were dismounted the revolutions were 112 per minute. This at once proves that the effect of the screw depended on its great number of revolutions. Let me not be understood to say, that the greater the number of revolutions the greater the speed; there is a limit, of course, for you may so *spin* the screw round that the fulcrum will be destroyed, or in other words, it will be working in a void. It may here be asked, perhaps, "What is to become of *expansive force?* Will you get the same proportion of speed with half steam as you do with paddle?" I say most emphatically, *no;* you must screw away, and so will your coals from the coal-boxes. In fact, in a screw vessel, it will be nonsense to talk about *screwing* out the coals. Very unfortunately, the shaft for driving the screw broke just as they were about to try the screw at the different steps of expansion, and it will be now some time before they can get a new one; so the experiments must stand over.

They have tried the paddles, having a long hawser the same length as they had for the screw; pressure by dynamometer, 704 lbs.; revolutions per minute, 16; steam in boiler, 7lbs.; barometer, 27⅞. If ever the screw in any form achieves as much with the same quantity of steam, I shall be much surprised.

P.S.—The screw people about here are looking very blank since the trials with *Bee*, and, as a matter of course, do not think the experiments worth much! What would they have said if it had come out the other way? Why, it would have been a most beautiful experiment—under the same circumstance, same horse power, &c., &c.

ELECTRIC LIGHT.

Sir,—I would be glad to describe the best mode of producing the continuous electric light, but I am unable to do so.

Mr. Weeks, of London, I believe, succeeded pretty well, about ten years ago. I understand that a very successful apparatus has been got up at Cincinnati, in America. And it was last year, or the year before, that an intense light, of a blueish tinge was procured in Paris, by galvanism acting on certain media.

Last year, in the *Builder*, and *Literary Gazette*, severally, two different forms of apparatus, one in which platinum cylinders, the other charcoal cylinders, were resorted to, were described, for the production of the electric light. I caused one of the descriptions, that describing the platinum cylinder, to be transcribed, and put it into the hands of an ingenious scientific friend for the purpose of arranging the best means of getting up the light, and determining the cost,—which promised to be about 20*l.* The experiment was given up on the score of expense, and the paper was mislaid.

The following paragraph, the last I have seen on the subject, I copy from one of the periodicals of the day. "At a late meeting of the Paris Academy, a letter was read from M. de la Rive, on the possibility of rendering the electric light available for the use of workmen in mines. This gentleman states that five or six elements of a pile of copper, and an amalgam of potassium sufficed to render incandescent two cones of charcoal inclosed in a small glass globe."

It is very strange that so important a subject receives so little attention in this country. That the electric light is practicable, I have no manner of doubt. I doubt not, also, that its adoption in mines would be the means of saving very many lives. The electric light, if brought to comparative perfection, would be also adapted for lighting tunnels, streets, and probably private house, for which its beauty and cleanliness strongly recommend it. There are endless stores of this wonderful element (electricity) in earth and air, if we would only, as I am convinced we one day shall, fully avail ourselves of it. I am, sir, your obedient servant,

H. M'CORMAC, M.D.

Belfast, Oct. 11.

NOTES AND NOTICES.

Walking on the Water.—From Hanover, we hear of a practical discovery, of a kind so curious as to require some further explanation before we can quite understand it; and we are rather suspicious, inasmuch as we have, or fancy we have, some recollection of a somewhat similar story making the round of the continental papers several years ago. It is given, however, in this instance, with an imposing detail and the guarantee of names—if there be no borrowing of these for the occasion. The report is, that two young men, one a Swede and the other a Norman,—taking the hint from that sort of footgear of fir-planks called *skies*, by means of which, in those northern countries, the inhabitants pass through valleys and ravines filled with snow, without sinking—have been exhibiting, in that capital, the exploit of walking on the water by means of *skies*—made, however, for the latter purpose, with iron plates hollow within. Backwards and forwards, much at their ease, according to the report, did the exhibitors walk and run—going through the military exercise with knapsacks at their backs—and finally drawing a boat containing eight persons—all without wetting their shoes. The Minister at War, has, it is said, put a portion of the garrison of Hanover under the training of these gentlemen, for the purpose of learning what might prove so useful a military manœuvre; and as MM. Kjellberg and Balcken propose carrying their invention into other countries, our readers will probably suspend their opinion till they have a nearer view of this novel meeting of *sky* and water.—*Athenæum.*

Flour and Potato Bread.—The attention of the French Academy of Sciences has been recently drawn to a new sort of bread made by a M. Clerget from wheaten and potato flour. The potato flour of M. Clerget, contains, not merely the farina, but also the fibre of the vegetable with its bran; it is free from unpleasant taste; it will keep for several years where the best wheaten flour would decay or deteriorate; and made into bread or biscuit, it is light of digestion and nutritious; mixed in the proportion of one part of potato flour to one part of wheaten flour, the bread is better than if made from the flour of wheat exclusively, and is about 30 per cent. cheaper.

Improved Locomotive.—It is gratifying to find that engineering skill continues to be applied, successfully, in the improvement of the locomotive engine. A new engine, called the Condor, has lately been constructed for the Liverpool and Manchester RailwayCompany, by their superintendant engineer, Mr. Durance. The improvements consist in having a double firebox, the combustible gases being consumed in the second, which would otherwise escape in an unconsumed state. By this means a considerable increase of heating power is obtained, and consequently, an increased speed. The most important feature of the new engine, however, is, that in addition to increased power and speed, the fuel used is coal instead of coke, and a considerable saving in expense is thereby obtained. This is, perhaps, the greatest improvement, as regards the economy of railways in Ireland that could have been suggested. Coke, the fuel used in England, must ever be a costly fuel in Ireland, particularly in the interior, inasmuch as the description of coal from which it is produced is not imported into this country; whereas ordinary coal, of good quality, is to be had on reasonable terms in all our seaports. The Condor now plying on the Manchester line, draws a greater number of wagons, at a higher velocity and at less expense, than any other engine.—*Irish Railway Gazette.*

The Avon steam-vessel, Commander Denham, is now nearly ready for sea, and being under orders to leave Woolwich on the 18th inst. for the Bight of Benin, considerable anxiety has been shown to in-

spect a vessel fitted for an African station. The Avon is fitted with Captain Smith's paddle-box boats, and on the sides of the paddle-boxes, numerous cabins have been constructed for sleeping on deck. A platform has been constructed nearly 10 feet above the deck, joining the two paddle-boxes to each other, and of the dimensions of 21 feet by 20 feet. The platform is immediately over the engine-room, and by the protection it affords to the engines, to preserve them from wet, the use of glass windows has been obviated, and wire gratings, about 2 inches and a half square, have been substituted, giving ample room for the circulation of air at all times. In the centre of the platform a window has been made, to add to the light of the deck underneath, and the whole has been joined, at Commander Denham's request, with marine glue. Commander Denham has also suggested that the cabin windows, and, indeed, every place for sleeping, should be supplied with extra frames, fitted with wire gauze, which permits the egress of the heated air of the rooms, while it checks the effects of the rays of the sun when the windows are open; and Mr. Lang, master shipwright, and Mr. Read, assistant to the master shipwright, have expressed their opinion that the application of the wire gauze, as recommended by Commander Denham, is one of the best plans of ventilation and protectors from extreme heat in tropical climates that could have been adopted. The Avon has been fitted with an invention by Churcher, for guiding the chain attached to the wheel when directing the helm; it appears to be very simple in its operation, prevents the chain getting foul, and is the first of the kind introduced into Her Majesty's service.

Alleghany Suspension Bridge.—This bridge is the work of a mechanic of Alleghany city. The suspension ropes which extend from pier to pier, in the form of an inverted arch, are to consist of seven strands of wire, each strand being about three inches in diameter. Four of these strands are already finished across the entire length of the structure, and the fifth will be completed to-day. The ropes will then be wrapped in annealed wire, (No. 14,) which will render it one solid mass; and as each individual wire is varnished before it is put across, and as the whole will be painted when finished and wrapped, it will be impervious to water, and consequently not liable to be weakened or impaired by the weather. On these two immense wire ropes the structure is to be suspended. But this is is not the only reliance for strength. The trunk is to be constructed from pier to pier; the sides being of solid lattice-work; that is, strong beams placed in this form—XXX. The beams are to be placed contiguous to each other for greater strength, so that when finished the trunk alone, without the wire-ropes, will be a firm and strong structure, capable not only of sustaining its own weight, but also of bearing up as much additional work as a lattice-work bridge would do. In effect, the trunk is a lattice-work bridge without arches. The ropes, being suspended across strong stone towers placed upon the piers, are, in fact, inverted arches, capable of sustaining more than double the additional weight which the letting-in of the water would place upon the trunk; the trunk itself is an independent, strong, and immovable structure, so that when finished, the aqueduct will not be liable to be moved either from the swell of water or the effect of storms. The wires are carried across the river, from one pier to another, by a wheel which traverses the whole distance upon ropes, unbinding the wire from the reel as it goes. The ropes are moved by horse-power. The splices of the wire are made by placing the two ends together and winding them with fine annealed wire; and it is done so strongly that sufficient force will break the wire, but will not affect the splice.—*Pittsburgh Chronicle.*

Machine for taking Soundings.—A very ingenious contrivance for taking soundings at sea has lately been discovered by a Mr. Richard Wing. It is the application of electro-magnetism to this purpose. The instrument must be seen to be fairly appreciated. It is not cumbrous or expensive, being made of wooden bars about two feet long, in which the apparatus is placed. It is to be used in conjunction with a sustaining galvanic battery and an electro-magnetic bell. There are conducting wires, &c. The instrument is to be suspended by a strong line over the side of the vessel at any required depth, say 30 fathoms. The moment the instrument touches the bottom sufficiently to cause it to incline to an angle of about 22 degrees, indication is given by the ringing of a bell in any part of the ship most eligible for placing it. The great difficulty of ascertaining depths by the sounding lead in great depths of water and in strong currents would, it is asserted, be remedied by this invention, for the moment the machine from being perpendicular in the water fell horizontally, indication would be given.—*Times.*

Day and Night.—Nothing made so deep an impression upon our senses as the change from alternate day and night, to which we have been habituated from our infancy, to the continued daylight to which we were subjected as soon as we crossed the Arctic Circle. The novelty, it must be admitted, was very agreeable; and the advantage of constant daylight, in an unexplored and naturally boisterous sea, was too great to allow us even to wish for a return of the alternations above alluded to; but the reluctance we felt to quit the deck when the sun was shining bright upon our sails, and to retire to our cabins to sleep, often deprived us of many hours of necessary rest; and when we returned to the deck to keep our night watch, if it may be so called, and still found the sun gilding the sky, it seemed as though the day would never finish. What, therefore, at first promised to be so gratifying, soon threatened to become extremely irksome, and would, indeed, have been a serious inconvenience, had we not followed the example of the feathery tribe, which we daily observed winging their way to roost, with a clock-work regularity, and retired to our cabin at the proper hour, where shutting out the rays of the sun, we obtained that repose which the exercise of our duties required. At first sight it will no doubt appear to many persons that constant daylight must be a valuable acquisition in every country; but a little reflection will, I think, be sufficient to show that the reverse is really the case, and to satisfy a thinking mind that we cannot overrate the blessing we derive from the wholesome alternation of labour and rest, which is in a manner forced upon us by the succession of day and night. It is impossible, by removing to a high latitude, to witness the difficulty there is in the regulation of time—the proneness that is felt by the indefatigable and zealous to rivet themselves to their occupations, and by the indolent and procrastinating to postpone their duties, without being truly thankful for that all-wise and merciful provision with which Nature has endowed the more habitable portions of the globe. —*Beechey's Voyage of Discovery towards the North Pole.*

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

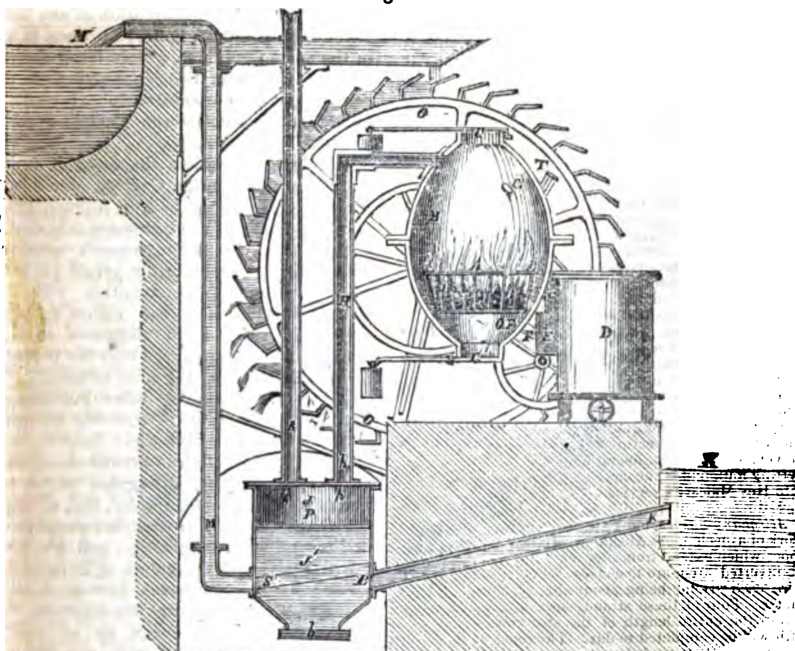
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1159.] SATURDAY, OCTOBER 25, 1845. [Price 3*d*.

Edited by J. C. Robertson, No. 166, Fleet-street.

GORDON'S PATENT FUMIFIC IMPELLER.

Fig. 9.



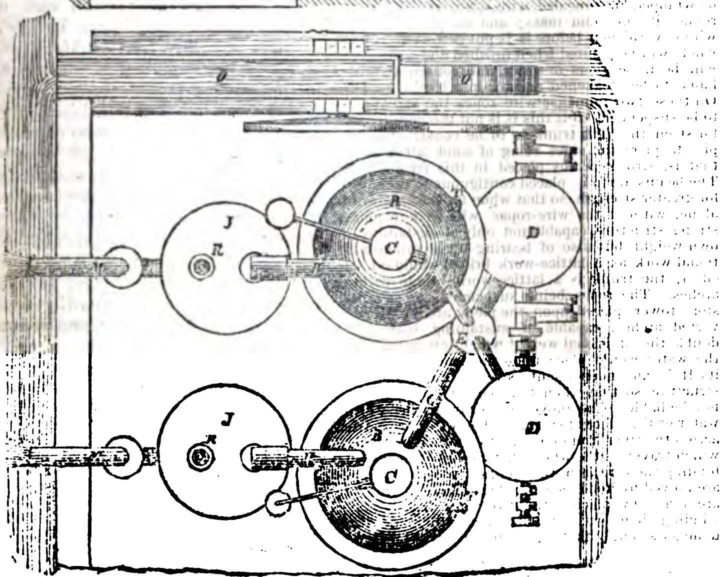


Fig. 10.

GORDON'S PATENT FUMIFIC IMPELLER.

[Patent dated March 3; Specification enrolled, September 3, 1845.]

THE inventor of this impeller is Mr. Alex. Gordon, the author of the well-known "Treatise on Elemental Locomotion." The present invention is stated to have been the result of a successful "course of experiments upon the action of the hot products of combustion when brought by rapid delivery into immediate contact with water;" and the general considerations which led Mr. Gordon to institute these experiments are fully explained in a pamphlet which he has just published.* We select from this pamphlet a few of its most striking passages:—

In the steam-engine, water exists in every stage of its history or operation. The heat from the fire separates the ultimate molecules of the water, overcoming their mutual attraction, and endowing each of them with a force of repulsion in proportion to the amount of heat. Heat, then, is the source of that power.

All solids, liquids, and aëriform bodies, may be heated and cooled, expanded and contracted; very few of them, however, can be applied as an elemental power, and still fewer of them can be employed as a power for locomotion or navigation. Some of the solids are used where power without speed is required, as in the case of iron bolts, rivets, ties, wedges. Some liquids, as for instance, spirits of wine, ether, ammoniacal liquor, liquid carbonic acid, have been proposed and experimented upon, with the view of being employed as means for an available motive power, by the alternate application and abstraction of heat; but water has *hitherto* been found the most convenient and economical *means* for obtaining power from the chemical action of heat; and to this is due the general adoption of the steam-engine.

Many attempts have been made to employ air as the means for obtaining power from the chemical action of heat. Some inventors have followed the manner in which water is treated in the steam-engine—by keeping the air altogether distinct from the fire, and transmitting the heat of the furnace through the materials of a tight chamber (like a boiler). Of these the most successful have been the productions of Mr. Ericsson and Mr. Stirling.* Others have used the products of combustion by bringing them (without the intervention of any heating chambers like a boiler) at once to act in the piston-cylinder. This latter process was introduced in Sweden,† and more recently has been carried into experimental operation by Sir George Cayley under a patent.

But, prior to either the Swedish engine or that of Sir George Cayley, Mr. Robert Stein, of Edinburgh, had, in August, 1821, obtained a patent for improvements in steam-engines, and his improvements consisted principally in directing the actual products of combustion in combination with the steam, at once into the piston cylinder. *Sometimes Mr. Stein dispensed with a boiler and water*, and used only the products of combustion from the close furnace.

All of these, and all other inventors of hot-air engines, have taken the steam-engine piston and cylinder as their models; and, although several of them proved clearly that air is more economically heated to the required temperature than water, and, although Sir George Cayley proved this economy of fuel in an extensive practice, and Mr. Stirling has shown the economy to be immense, no one has yet contrived how to maintain the durability, and, by consequence, the current economy of a hot air or caloric engine, when a piston and cylinder are operated upon at once by the products of combustion. And of Mr. Stirling's engine it may be said, it bids fair to rival the steam-engine for manufacturing purposes, such as the impulsion of mill-machinery.

It is not necessary to enter into a tedious narrative of the hot-air or caloric engines just referred to, nor to enumerate the various attempts to make hot aëriform bodies actuate a piston in a cylinder.

It may be asserted that hot aëriform bodies have not been successfully employed hitherto as the agents, because the great sensible heat has speedily destroyed some part of the machine; and because water has been preferred as the material, on account

* Description of the Fumific Impeller; showing the direct Application of the Hot Production of Combustion to the Bodies on which they are required to Act without the Intervention of Machinery. By Alexander Gordon, M.I.C.E. Dalton, 1845.

* A full description of this elegant engine, with illustrative drawings, was presented to the Institution of Civil Engineers by Mr. Stirling, of Dundee, and a long discussion, on its construction, action, and economy, took place, to which I beg to refer. It will be seen that great difficulty was experienced by members in understanding the action of Mr. Stirling's air-engine. It appears to have been difficult of comprehension, principally because the steam-engine is naturally taken by engineers as the standard of perfection.

† See description by Mr. Ericsson, in a paper existing in the Institution of Civil Engineers.

Fig. 6.

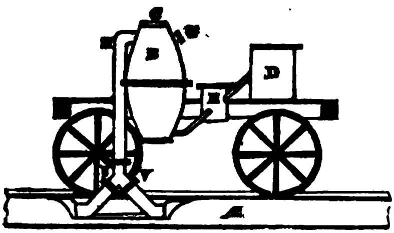


Fig. 7.

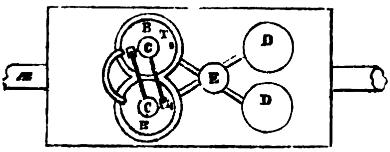
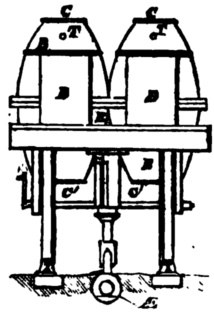


Fig. 8.



of the ease with which it can be procured, replaced, and managed.

It has been said before, and cannot be too often repeated here, that heat is the source of power. And it would be absurd to suppose that any intelligent person considered that the machinery, or any part of it, from the paddle-floats of a steam-boat, back to the boiler, really augments the power which proceeds through the boiler, and along the steam-pipe. The power, *i. e.* the combined mechanical agency of elasticity and momentum of which the steam consists, is within the steam-pipe. The engine, machinery, and paddles only offer the means of bringing that power to operate upon the water, and urge the ship in her course.

The proposers of hot-air engines have taken the steam-engine, subsequent to the discoveries of Newcomen, as their model, whilst they should have reverted at once to the engines of Savery and of Papin. They should be referred to the Marquis of Worcester's scantlings, and even to the smoke-jack of Hieronymus Cardan.

The Marquis of Worcester employed the pressure of steam to act at once and directly upon the water which he desired to put into motion. Savery, also, used steam in direct connexion with the water. Denis Papin improved on these by interposing a loose floating piston between the steam and the water to be moved.

Now, had any one of these latter used, instead of steam, the hot products of combustion from a close furnace, the steam-engine would not now be the only available inanimate artificial power in use for such purposes as raising water, and for locomotion and navigation.

* * * *

My invention and its value, are embodied in three simple axiomatic propositions, which interested or ignorant opposition may challenge, but I defy it to overthrow.

1st. That heat is the source of power in all our artificial motive agents.

2nd. That machinery does not increase the power of any machine, but only transforms or transfers the motion.

3rd. That the expansion arising from a given amount of heat applied to gaseous bodies is much greater than from the same amount of heat when applied to liquid bodies.

The first two propositions will be admitted as correct by any tyro. We need not stop to examine them. Our discussion of the third proposition shall be as nearly as possible in the words of the best chemical authorities.

"It may be laid down as a general rule, to which there is no known exception, that every addition or abstraction of caloric makes a corresponding change in the bulk of the body, which has been subjected to the alteration in the quantity of its heat."*

From the experiments of Dalton, Gay Lussac, and others, it is well established that all gaseous bodies whatever, similarly circumstanced, undergo the same expansion by the same increments of heat; and Dr. Ure adds his testimony that "Expansions of aëriform bodies are proportionate to the augmentation of temperature;" and in the words of Dr. Thomson, the expansion and contraction differ exceedingly in different bodies. "In general, the expansion of gaseous bodies is greatest of all."

We proceed now to give the description of the Fumific Impeller, as it is contained in Mr. Gordon's specification :—

Fig. 1 is a sectional elevation of such an

* Thomson's Chemistry.

apparatus, as will explain the nature and action of the Fumific Impeller. A, is a fire-grate inclosed in a strong close furnace B B. There is on the top of this close-chamber B, a bonnet-valve C; and at the bottom there is another bonnet-valve C′.*

The valves being open for the purpose of laying and lighting the fire, which may be of coal, wood, coke, charcoal, peat, or of any other fuel: and the fire having attained a good state of combustion, the valves C and C′ are well luted and closed tightly on their respective openings.

D is a blower, which supplies atmospheric air to support the combustion in the close furnace. The air being directed by means of the valve E, so that it shall pass through the pipe F or the pipe G; the former conducting it under or up through the fire, and the latter to the top and over the fire; thus the exact quantity to pass through or close to the fire may be regulated for consuming a quantity of fuel sufficient for producing the hot products required for the fumific influence; and thus the speed and power of the Fumific Impeller may be increased or diminished. H is a pipe leading off from the top of the close furnace, by which the hot aëriform matters generated by the process of combustion are carried off to be applied in the manner which shall be explained more fully below; and these hot aëriform products of combustion are intermingled usually with some dust, ashes, and other solid matters, but which do not interrupt the dynamic action of the gaseous body.

Air, it is well known, will, when heated by one degree of Fahrenheit, expand about $\frac{1}{480}$th part, and continue to expand so as to have its expansive force or tendency increased in about the same proportion for every additional degree of temperature.† It follows that if the temperature of a permanently elastic aëriform body be augmented by about 480°, the bulk of that body will be doubled, or if it be retained within the space it originally occupied, its pressure will be doubled. It is by availing myself of this well-known law of expansion by heat and the new arrangement of particles in the close furnace, that I can obtain a rush of power from the furnace along the pipe H, analogous to the rush of steam from a steam-engine boiler along the steam-pipe to the engine,—equal to it in pressure, power and constancy. *and, when required, at much greater velocity.*

The air driven into B for support of combustion must, of course, be driven in against the pressure due to the heat of the products of combustion; for, supposing the latter are at the temperature of about 500°, there will be an atmosphere of surplus pressure against the blower; and it will be found that the blower, to do its work, will require a power of half the power generated by the heat. The manner in which this blower is worked, and also the manner of starting the engine, are shown below.

It has been before shown, that the power of a steam-engine is from the fire "through the boiler and along the steam-pipe; that the power—*i. e.* the combined mechanical agency of elasticity and momentum, of which the steam consists—is within the steam-pipe." Now, in the Fumific Impeller, the power—*i.e.* the combined mechanical agency of elasticity and momentum—is in the hot products of combustion themselves, which are in the pipe H.

In a steam-engine, the power of heat is necessarily transmitted through a costly and elegant system of machinery to act upon the bodies, which it moves or which it moves upon; the steam being carefully prevented from contact with any body but its own engine. In the Fumific Impeller, the power of heat is brought without the aid of any transmitting machinery, to act directly and at once upon the body or bodies to be put in motion, or on the medium or media in, or on, or through which the ship, or machine, or carriage, is to be moved or impelled.

A stream or streams of the hot products of combustion are discharged under water backwards, and the vessel moves forward, or they are discharged forward, and the ship is moved backward. It is a case of recoil analogous to that which takes place in a rocket occasioning its flight, but differing from that

* B the inside of this close furnace is constructed of fire-clay, or fire-tile, and the external shell is formed of wrought-iron, of sufficient strength and sufficiently tight to resist the pressure from within. It might be made altogether of iron; but if the iron were not protected by some inner casing, it would not withstand for any great length of time the high temperature to which it must necessarily be exposed.

C C′, these valves are kept tight upon their seats by means of the usual springs or weights, and not only serve for closing their respective apertures, but they are arranged so that they can blow open as safety-valves, when the pressure from within shall exceed the power of the springs or weights employed to keep them close.

T is a pipe fitted in the close furnace, which, being provided with a talc-sight, enables the attendant to see the state of the fire."

† Dalton determined that 100 parts of air being heated from 55° to 312°, expanded to $132\frac{5}{10}$ parts; this gives us an expansion of $\frac{1}{488}$ parts for 1° Fahr. Gay Lussac determined the expansion to be $\frac{1}{480}$; and although in Sir David Brewster's edition of Robinson's philosophy, $\frac{84}{10000}$, or about $\frac{1}{417}$, is stated, we find Dr. Ure, in his 'Dictionary of Arts' (article 'Expansion,'; states that all gases expand $\frac{1}{480}$ for each degree of Fahrenheit.

of the deadly missile, in being *manageable and safe.*

Let us now see how a ship may be fitted and actuated by the Fumific Impeller.

Fig. 2 is a longitudinal view of the midships and after-part of the ship, with the midship part shown in section. Fig. 3 is a plan of fig. 2, and fig. 4 is a cross-section of the same.

The functions, actions, and mutual relations of the fires; the close furnaces, B B; the valves, C C′ C C′; the blowers, D D; the cocks or valves, E E; the pipes, F F and G G; and the pipes H H, which lead off the power from the close furnaces, need not be described here. They will be understood to be a double arrangement of what has just been shown and explained in fig. 1.

The products of combustion intermingled with any dust, ashes, or other solid matters, (even cinders and clinkers,) are caused to rush along the pipe H on each side of the ship, and through one or other of the valves U or V directly into the water. If, on the larboard side, the valve U be opened, and the valve V be shut, while the valve U on the starboard side is open, and the valve V shut, the products of combustion must then rush out at the discharge pipes, W W, and overcome the inertia of the ship, and the continuous flow of power from W continues the onward movement of the ship.

The ship having been put into motion, a fan or screw X in the dead-wood of the ship is, by the motion of the ship, caused to revolve, and its shaft Y gives motion to the tight-blowers or air pumps at D D.

As the valves U U may be used for impelling the ship forward, so the valves V V may be employed to back the ship, and the valve U on one side of the ship, and the valve V on the other side of the ship, may be employed to put the ship about.

The pipes branching from the valves U and V may be kept inside of the ship, and made to terminate and discharge the power when the moulding of the bottom bilges or other submerged part of the ship may intersect them. Z Z is a folding chimney with a sliding part at the lower end for carrying away the smoke and vapour when the valves C and C′ are opened. Fig. 5 shows a plan of the interior of the discharge pipes leading from the valves U and V. The curved partitions *t t* are useful to direct the current forward or aft as may be required.

To put the impeller in motion a few cubic inches of water are injected, by a small pump or hopper, into the fire, which water flashing into an aëriform state (partially or wholly decomposed) gives the first stroke or strokes to the Impeller. Or, instead of water, a solution of nitre, which will also be found very useful in getting the fire into greater activity.

The combustion of the fuel may be accelerated, and also additional heat be obtained, by injecting into the closed furnace from time to time, by means of the blower D or any other blower, some coal-dust, or powdered rosin, or other pulverised combustible or supporter of combustion. But whether such materials are blown in singly or together, they should be introduced into a cold part of the blast pipe, blown or dropped upon the fire, not passed up through it. Of these auxiliary materials coal-dust will, perhaps, be found the best to employ, for it can be readily obtained; and, as it inflames rapidly, there is, consequently, a rapid augmentation of the volume of heated air and vapours.

Sometimes these auxiliary materials may be forced into the close furnace by means of a hopper, which may be kept air-tight by a double mouth-piece, or the hopper may deliver the said auxiliary materials, by means of a cock half perforated, or a fluted roller. One or more short tubes T fixed in the upper part of each furnace (with eyepieces of talc, for the purpose of keeping in the pressure) serve to sight the condition of the fire.

The bonnets or valves C and C′ can be opened as often as necessary in order to clear the fire-grate or to supply fresh fuel, and they are rendered tight by means of asbestos and white or red lead as a luting, or by means of other good luting.

Sometimes a close hopper or hoppers with double mouth-piece, may be adopted for supplying the whole of the fuel to the fire, and sometimes it is advantageous to supply through such hopper a mixture of coals and water.

The proportions, between the area of the fire-grate or fire-space and the area of the pipe H to be preferred, are about the proportions at present adopted by makers of marine steam-engines in their fire-grates and main steam-pipes. But the Fumific Impeller may be worked with a smaller proportion of fire-grate; because, not being delayed by the process of transmission of heat through metal, (as is the case in a steam-boiler,) but being as rapid in the generation of power, as is the appropriation by fire of oxygen from the air blown in, there can be no other limit set to its speed.

It will now be easily seen how a locomotive engine may be impelled by this motive agent.

Figs. 6, 7, and 8, exhibit sketches of an application of my Fumific Impeller to locomotive or railroad purposes; fig. 7 being a

longitudinal section; fig. 8 a plan, and fig. 9 a cross section.

The general arrangement of the close furnaces, air-pumps, and pipes, common to my Fumific Impeller need not be described again here. The four or more wheels of the locomotive are placed upon the rails. Æ is a continuous tube or pipe similar to the pipes for atmospheric railway communication. Through the continuous opening at the part of the tube Æ, the pipe H is made to discharge the hot products of combustion, either through the valve U to impel the locomotive forward, or through the valve V to impel the locomotive backward, the discharge pipe from U delivering the hot products of combustion, the impact is got upon the air or aëriform fluid in the pipe Æ. The use of this pipe Æ being principally to prevent the lateral escape of the impelling and the resisting bodies, it may be made of iron or other suitable metal, or it may be constructed in masonry.

Instead of the continuous tube, as shown in figs. 7 and 8, a continuous trough of water or canal may be under or at the side of the railway, and the pipe H and delivering apparatus may be led so as to act under the surface of the water, whilst the weight to be carried, the close furnace and other machinery or apparatus are transported or borne on wheels or a carriage.

It is obvious that by causing an arrangement similar to the one above described (in figs. 6, 7, and 8,) to be employed in a carriage, to be impelled on a road surface other than a railway, or upon turf, or other way, the inertia may be overcome, and the carriage maintained in motion by the projection of the products of combustion backwards when the carriage is to be impelled forward, and forward when the carriage is to be backed. But in this case I prefer not to depend upon the products of combustion driven wholly into the surrounding atmosphere, but to force them diagonally downwards, so that impact may be had upon the road or way. In case of locomotion the air-pump is actuated by the revolution of the axle.

Fig. 9 is a sketch of an apparatus wherein the Fumific Impeller is applied to the raising of water from one level to another. J is a cylindrical working chamber which has been nearly filled with water from the level K through the pipe *k*, and communicates at top with the pipe at H. When the hot products of combustion enter J, their pressure on the surface of the contained water closes the inlet valve L of the pipe *k*, and forces the water up the pipe M to the higher level N.

We have seen, on pages 9 and 10, that part of the power obtained by the hot products of combustion must be used for pumping air into the closed furnace. When water is pumped up, part of it must be used to work the pump; therefore, from N a portion of the water is returned back by the channel *o* to actuate a water-wheel O which works the blower D. The same water-wheel works the valves Q and S, which are necessary when the working chamber J is used. When the water in the working chamber has been depressed by the pressure to the level J′, the water-wheel O opens the valve Q of a waste-pipe R to permit the escape of the now expanded aëriform products, and closes simultaneously a valve *h* which commands the mouth of the pipe H. The working chamber J is now refilled with water from the level K by the superior pressure of the water in the direction of the pipe *k* and the valve L, and as soon as refilled, (or nearly so,) the water-wheel again opens the valve *h*, and the process of forcing up the water to N, above described, is repeated. On the top of the water in J there may be a float in one or more pieces of stone, wood, or hollow metal P, to prevent or lessen the splashing of water, and at the bottom of the chamber J there is a trap and man-hole door *b*, through which the ashes, cinders, and other solid matters which collect there may from time to time be withdrawn. When only one close furnace B and one working chamber J are employed, it is necessary that the blast of atmospheric air should be also regulated by the water-wheel O, or by manual or other power. But it is preferable to work with two close furnaces, two working chambers, and two blowers, (as shown in plan, fig. 10,) whereby a continuous action will be obtained. And in this latter case one water-wheel is sufficient for blowing the air and working the valves.

To start this engine it will suffice to use some water from the higher level N to set the water-wheel and blower in motion, but should there be no water in the higher level N, it will be necessary to inject a small quantity of water or solution of nitre into the close furnace, as explained in describing fig. 1. A branch pipe from the rising main M may be laid so as to throw some of the first water raised by J upon the water-wheel.

Readers acquainted with the early history of the steam-engine will recognise in the working-chamber of this engine (figs. 9 and 10) an action of hot air similar to the action of steam in the proposition of the Marquis of Worcester, and in the practice of Savery and of Papin, as they are described by Tredgold and by Farey.

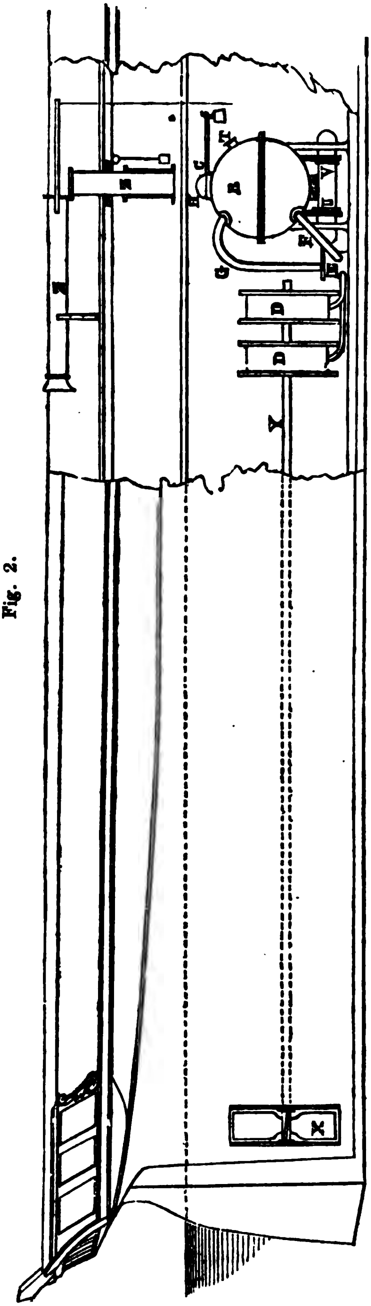


Fig. 2.

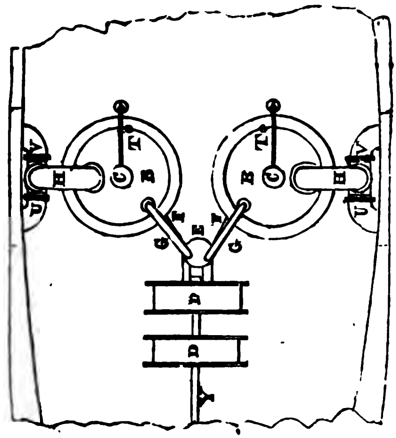


Fig. 3.

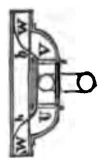


Fig. 5.

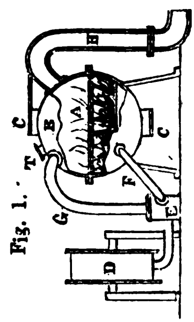


Fig. 1.

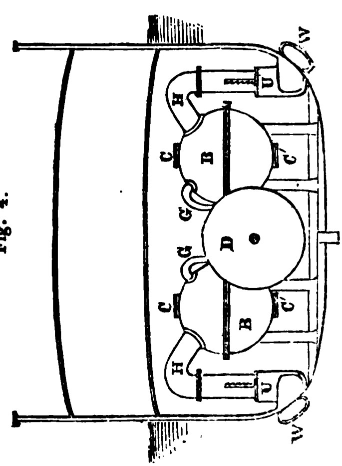


Fig. 4.

MINERAL WEALTH OF SOUTH AUSTRALIA.

When Mr. Mengé published, some years ago, his catalogue of South Australian minerals, various degrees of credence were vouchsafed to the extraordinary list, a credence, in short, proportioned to the readers' acquaintance or otherwise with the talented and worthy, but somewhat eccentric author. Not only, however, has all that Mr. Mengé predicted respecting the metalliferous minerals of this colony been fully realised, but there appears to be no lack of precious stones, the existence of which here, was at one time, and that not long ago, looked upon as apocryphal. We have to-day to announce the gratifying intelligence (gratifying to every colonist and most fortunate for the worthy proprietor) that upon one of the sections in the centre of Flaxman Valley, the property of George Fife Angas, Esq., there has been discovered an astonishing combination of metalliferous minerals and precious stones. The metallic substances comprise veins of rich copper ore intersecting the land, and lead in several parts; whilst, in a large formation of *hornstone*, lie embedded, in considerable masses, the kind of opal called "precious," as well as white and red cornelian, agate, and jasper. Asbestos, which is so frequently and variously met with in the district, is also found upon the property referred to, as well as white marble of considerable purity, and large quantities of excellent freestone. Neither is the great mineral feature of the province wanting in this locality. Iron in almost every variety is there, and in such manifest abundance that its quantity seems to be almost without limit. In short, after what we have seen, and been assured of, we may say in perfect truth and soberness, that if future iron-works, as vast as those which now operate and find their raw material in Britain, should one day be established here, or draw their supplies of ore from this province, the "iron-masters" will find inexhaustible stores beneath the millions of tons of surface mineral, which so frequently meet the eye of the mountain explorer.—*Adelaide Observer*.

SCREW-PROPELLING, NEW FORM OF SCREW.

Sir,—I beg to hand to you a plan and description of a propeller, which has not yet been published, and which I conceive possesses decided advantages over all those now in use.

It is a well-known fact, that to all vessels in motion there is a certain amount of after-current, proportioned to the speed at which they are driven, and to the fulness of their water lines abaft; this after current being greatest directly bhind the stern-post and decreasing as the distance from it increases. Such being the case, it follows that a propeller placed at the after-end of a vessel must, when the vessel is under way, be travelling through water which is passing it with a different velocity at different points in its diameter; for example, in a vessel having a very full run aft, the water might, at the centre of the propeller, be leaving the vessel at the rate of 5 miles an hour, and that, at the extremity of the blades, at 10 miles an hour. To meet this difference of velocity in the water, and to obtain an equal amount of end pressure on every square inch of its surface, the propeller ought to be made with a pitch gradually and uniformly increasing from the centre to the extremities of the blades. This difference of pitch would, of course, vary with every variety of form of vessel; being for very bluff vessels, perhaps as much as 50 per cent., and for fine vessels, perhaps only 5 per cent.

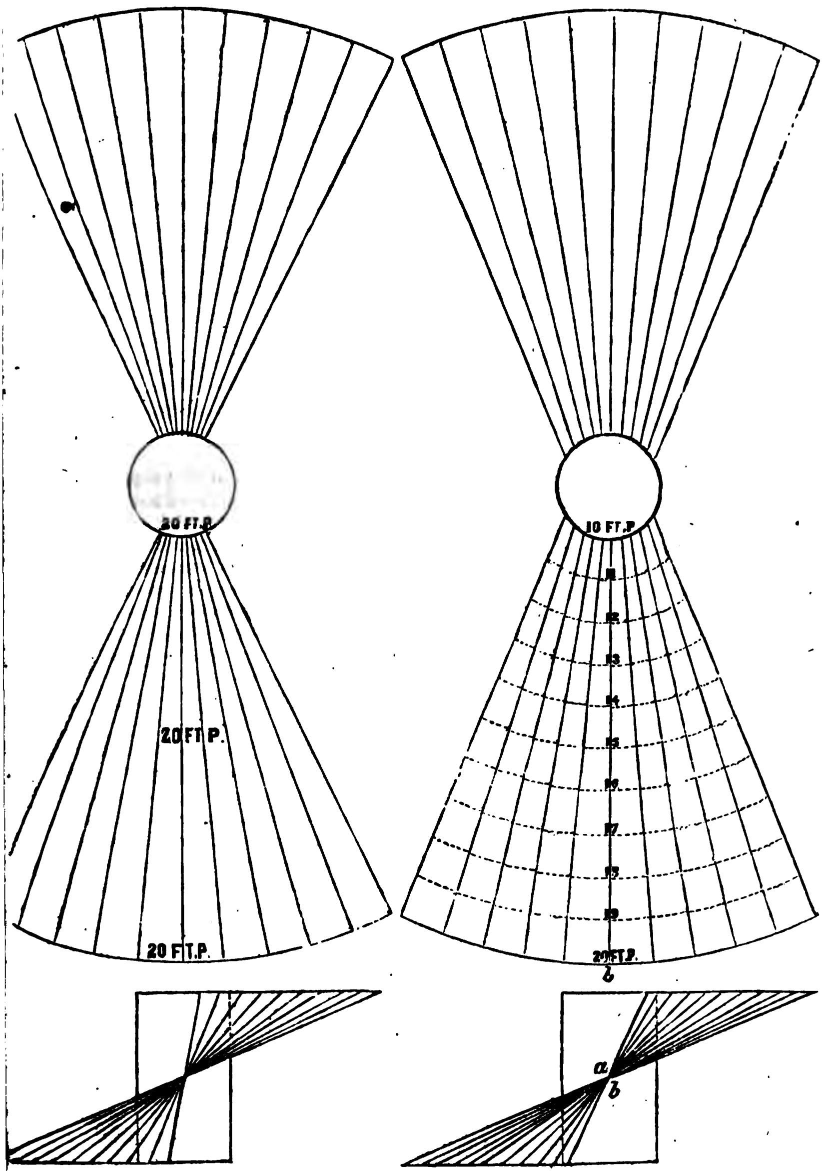
Such an arrangement of propeller as this would, I am certain, produce a more useful effect than can be obtained by a propeller with a uniform pitch from the centre to the outside, as the centre parts of the blades of a screw of an uniform pitch lie so much in a line with the direction of the vessel, that they can only absorb the power of the engines by thrashing the water round.

In the annexed sketch, I have shown a common screw of an uniform pitch (fig. 1); and, for the purpose of showing more clearly the difference between it and the improved one, I have shown an extreme case of the latter, and made the pitch at the centre, half that at the outside. The diameters are supposed to be 20 ft., and the pitch of the common screw 20 ft. throughout; that of the improved propeller, 20 ft. at the outside, and 10 ft. at the centre part. The figures on the radial line show the pitches at those points. You will perceive that, in the improved propeller, the blade is radial only in the centre of its length, that is, on the line *a b*, and that at any other point it is a tangent to a circle whose diameter is proportional to the distance of that point from the radial or centre line. I am, Sir,

Your obedient servant, P. P.

St. John's-wood, Oct. 2, 1845.

P.S. The reader will find a sketch in Tredgold's Appendix on Screw-propelling, which shows the after-current I have alluded to.


20 FT.P
20 FT P.
20 FT.P.
10 FT.P
20 FT.P.
b
a
b

ON THE WORKING OF STEAM EXPANSIVELY IN THE ROYAL STEAM NAVY.

[Continued from page 265.]

" 'The most judicious system then in this respect is to give steamers machinery in the proportion of 50 horse-power *engines*, but *cylinders* for 60's, because we hereby conjoin lightness with efficiency; especially if applying steam *expansively*, as we have the power of increasing the 50's to work up to the power of 60's or 70's, a practice, as already noticed, not unusual.'

" But the plain evidence of facts is superior to all declamation; the *Great Liverpool*, subsequent to my writing my letter to Sir William, broke one of her pistons, and steamed from Alexandria to England, a distance of upwards of 3,000 miles, at an average velocity of 7 knots 2 fathoms, which is as high an average as could possibly be expected from her maximum velocity. Here then, I owe to chance an overwhelming fact, for it is affirmed by all that have written on the subject that the quantity of steam generated is in direct proportion to the fuel consumed; then, as one of the *Great Liverpool's* cylinders could only consume the half of both, we have half the steam saved, consequently half the fuel. *Ergo*, I have proved my point.

" Still however it will be interesting to call your attention again to my letter to Sir William. In that letter I mentioned in paragraph the second, that the theorist takes the numbers 7 and 9, and in those numbers he is confirmed by Captain Oliver; but how can he state that to be in accordance with the law of the squares? for the square of 7 is 49, which is something more than the half of the square of 9·—6, and $\frac{4}{10}$ would be nearer the truth, for that squared gives 40 and $\frac{96}{100}$: it is correct though, nevertheless, for my own experiments in the *Alecto* confirmed the accuracy of Captain Oliver's statements, as I ever found the velocity was higher than the squares would give by about three-quarters of a knot, though varying two fathoms more or less. This again I attribute to less friction at the lower velocity; and now I have shown what I promised, when speaking of the injury done to the *Hydra's* engine by keeping her at her maximum rate.

" The Austrian Admiral having run ashore on a shoal off Acre, we in the *Cambridge*, then at Beirout, were ordered to weigh immediately and proceed to her assistance. The *Phœnix* took our launch in tow and arrived before us. Lieut. Knox, one of our officers, dining with us on our anchoring, when asked what time they had arrived, replied, 'before daylight, but not wishing to come-to before we could see the Austrian's position, shut off half the steam; but the old vessel took a fit of running, and would go from six and a half to seven knots.' My messmates smiled, for they knew how unwittingly he was corroborating what I had written about the *Phœnix*.

" In the deductive reasoning which I here adopt, I wish strongly to impress on your attention, Sir Graham, this singular fact: that I have the best corroborative evidence possible to obtain. I have the theorist departing in a trifling degree from his theory in support of the fact: I have the practical man of observation giving me the result of his experiments though ignorant of the theory; and I have an officer affirming the correctness of the latter's attestations, though conceiving the truths he was relating to arise from accidental causes.

" Should there be a sceptic still, with whom the weight of such evidence will pass for nought, I fairly challenge him to assign any plausible reason for the *Great Liverpool* averaging a velocity of 7 knots 2 fathoms with *one* piston, upwards of 3,000 miles, if the theory I affirm to be true has no existence but in my imagination.

" I have certainly been desirous of establishing the theory of the squares on so broad a basis that it will not easily be shaken; for I feel that, by a careful consideration of this beautiful theory in all its ramifications, the greatest benefit will accrue to steam navigation: for this end I propose to trace how far a competent knowledge of this subject will serve to illustrate the 'expansive system;' how far it may tend to direct our judgment in handling vessels at sea, and how far these, taken in conjunction, will conduce to the general economy of fuel.

" Before I enter upon these topics, I think it absolutely necessary to define some mechanical laws, which, without they are clearly understood and admitted, may cause any future reasoning to appear not very intelligible.

" 'It is an error to suppose that rest is the only condition possible for a body to assume, when under the operation of two or more mechanical forces which are in equilibrium. By the laws of motion, the state of a body which is not under the operation of any external force must be either in a state of rest or uniform motion. Whichever be its state, it will suffer no change, if the body be brought under the operation of two or more forces which are in equilibrium: for to suppose such forces to produce any change in the state of the body, whether from rest to motion, or *vice versa*, or in the velocity of the motion which the body may have previously

had, would be equivalent to the supposition that the forces applied to the body, being in equilibrium were capable of producing a dynamical effect; which would be a contradiction in terms. This, though not always clearly understood by practical men, or by persons superficially informed, is, in fact, among the fundamental principles of mechanical science.'

"Now, is it not strange that, though this sentence is extracted from 'Lardner upon Steam,' that the word '*momentum*' should never be encountered, and that in all his arguments in his sixth edition against the possibility of crossing the Atlantic to New York, the advantage to be derived from increased '*momentum*' should be entirely overlooked, as if it were *not* capable of producing a higher average velocity?

"Let me now quote the Doctor against himself, by citing a few lines from a work, in which he acknowledges to have had some share in the composition.

"'From the preceding details it appears that, *motion* is not adequately estimated by *speed* or *velocity*. For example, a certain mass (A) moving at a determinate rate has a certain quantity of motion. If another equal mass (B) be added to (A) and a similar velocity be given to it, as much more will evidently be called into existence. In other words, the *two* equal masses A and B united have *twice* as much motion as the single mass, A, had when moving alone, and with the same speed; the same reasoning will show that *three* equal masses with the same speed have *three* times the motion of any one of them.

"'In general, therefore, the velocity being the same, the quantity of motion will always be increased, or diminished, in the same proportion as the mass moved is increased or diminished.'—*Kater and Lardner on Mechanics*, page 39.

"I will now illustrate the advantages possessed by the larger vessel over the smaller, by taking some case in point. Suppose therefore the two vessels be that beautiful little steamer *Locust*, and the *Great Liverpool*, the tonnage of the former is about 291, that of the latter 1560. Now it is asserted of the *Locust*, that in perfectly smooth water they have obtained a velocity of 10½; and that is equally affirmed of the *Great Liverpool*: but two vessels that steam at the same rate cannot show the one to possess any advantage over the other; consequently, as long as circumstances remain the same, they must pass over an equal quantity of ground in the same time, directly; however any undulation shall retard their velocity, the loss of the one will be in proportion to the loss of the other, as their different *momenta* bear to each other; for, the sea being an obstructing force, the vessel with the greatest *momentum* will be best able to overcome it. The same is evident when we wish to select a vessel to tow another to the greatest advantage: multiply then the tonnage by the velocity and we find the relative *momenta* in the cases cited.

"This law was beautifully exemplified a short time since by the *Great Liverpool* and *Megara*; but, singular enough, none traced the effect to its true cause; the gain being solely attributed to the different 'powering' of the two vessels. Captain Engledue himself assigned that reason to me in these words: 'I expected we should beat her, as no Government vessel has sufficient horse-power.' I will now relate the particulars. In consequence of the *Great Liverpool* having broken one of her pistons, and therefore working but one engine, Admiral Sir John Louis sent some dispatches of importance by the *Magara*, taking it as matter of course she would arrive first at Gibraltar; but the *Great Liverpool*, as Captain Engledue had anticipated, beat the *Megara* in this instance by even as much as 10 hours.

"Now how is it possible to assign the cause with any show of reason to the superior power of the *Great Liverpool?* for both engines have equal power; therefore if she had lost the use of one, her power was reduced to one half, viz. 232-horse, and which power had to impart motion to a double quantity of matter, as their tonnage is as 1,540 to 730.

"It is true, other causes might possibly be assigned by a close inspection of both logs; but it must be granted me, that, if I have not clearly established my own point, I have most satisfactorily demolished that of my friends; let the cause be what it may, the case is a remarkable one, and well worthy of consideration.

"As I have occasionally used the words *maximum velocity*, I think it advisable that I should define its meaning; for however strange it may appear, the want of having this clearly explained has led to much error. This, then, is what I would wish understood; it is the highest velocity obtainable from any vessel, at her average or mean draught, with the greatest *beneficial* use of *power;* this, in my opinion, can only be found in perfectly calm weather and smooth water, free from the effects of tide and current; any higher velocity than this, such as that shown by running in a gale of wind, I term '*casual*,' as it can never form data for any calculations. Were this carefully attended to, much useless argument would be saved; and much labour in reconciling apparent contradictions,

"I will now explain what steps are necessary to be taken to prove the law of the squares. Suppose ten miles an hour be the maximum from four boilers, and it be required to know what half the quantity of steam will give; close your throttle valve to one-half, the consequence will then be, that the half steam not drawn from the boilers will press on the safety-valve and escape; the velocity obtained will be 8 knots on the principles previously explained: as soon as you have satisfied yourself that half the steam entering the cylinder is attended with this effect, draw half the fires; for, as yet, you are generating steam to waste; but still take care to keep the throttle valve closed to one-half, for otherwise you would soon exhaust all the steam from your boilers: this is often resorted to, when the boilers do not generate steam fast enough to meet the demand of the vessel. Boilers, I cannot help conceiving, ought to be constructed to supply the full demand of cylinders with the most inferior coal, leaving it to the discretion of the commander to reduce his fires as may be necessary. Following this rule, from the above maximum the relative velocity from each boiler stands thus: one boiler, 5 knots 6 fathoms; two boilers, 8 knots; three boilers, 9 knots 2 fathoms; four boilers, 10 knots.

"I wish in this place clearly to define the difference of steam used thus, and that from the *expansive system*. Captain Otway has fallen into error in conceiving both to be attended with a mechanical effect; this is certainly a great mistake; 'steam* *wire drawn*,' as the former mode is expressed, has no mechanical properties; all the advantage to be derived from it is, that you obtain a higher proportionate velocity for the quantiy of fuel expended; not through any mechanical property in itself, but on the principle that the resistance increases according to the square of the velocity; the pressure is *constant* and *uniform* and *not* expansive.

"It is otherwise, however, with the beautiful law that governs the *expansive system;* here the pressure is not constant and uniform throughout the cylinder. I cannot help conceiving that the great advantage to be derived from *expansive steam* is not so clearly understood as it ought to be; for it involves a contradiction of terms to suppose parties to be insensible to their own interests, whether they be individuals or communities. Can it be accounted for by stating, that the few fully conversant with the subject will not condescend to make their definitions sufficiently intelligible to meet the understandings of the many, who, after all, as practical men, will have to carry it into execution? Be it as it may, in all the works I have read, much fault is to be found in the manner of bringing this subject under consideration, than which, short of the invention of the engine, there cannot be found one more important. Many are content with giving you the results of their calculations, without troubling themselves to explain how these results were obtained; others furnish us with an illustration in lieu of a definition, as if such would convey any distinct idea; but an illustration neither shows a perfect knowledge of the matter, nor will serve to make your ideas intelligible to another; even when most happy, they convey but imperfect notions; however, it is easier to illustrate than define. If you doubt the correctness of these remarks, only peruse what Captain Williams has written in his lectures on Steam, pages 14 and 32.

"I also gather from Captain Otway's writings that he has no distinct notions on the subject; for he fairly contradicts himself.

"Doctor Lardner seems to have a knowledge of the matter as far as the mechanical effect gained; though it is poorly explained in the 6th edition, in the 7th and last edition his definitions are certainly more intelligible; but is it not surprising that he doubts the applicability of *expansive steam* to steamers in his 6th edition, and in his 7th, though admitting it is *now* in *use*, forms all his calculations with regard to the expenditure of coal as if no such invention had ever been called into existence? Hugo Reid hazards little, and consequently is safe from criticism. How can any man by reading these, arrive at a satisfactory conclusion on a naturally abstruse question, when he finds it engulphed in such a sea of contradiction?

"But the Doctor, in denying the law of the squares, robs himself of the landmark that would safely guide him through these troubled waters; he loses his third term in a simple rule of proportion, which third term enabled me to speak with confidence as to the amount of the *loss* of velocity in proportion to the *saving* of fuel.

"I shall now try to define the *expansive system:* it is a mechanical property peculiar to steam thus used, by which, though you save one-half that would be required completely to fill the cylinders, you lose less than one-sixth of the effective pressure on the piston. A cubic inch of water will produce a cubic foot of steam: it has then ex-

* I have denied any mechanical properties to "wire drawn steam," merely to keep the advantage to be derived from "expansive steam" in the foreground; but all power exerted through an agent is strictly speaking mechanical: but this is not the sense in which it is used by Otway (see page 10); he confounds things which in their cause and effect are different.

panded into upwards of seventeen hundred times its volume, and exerts a mechanical power equal to raise a ton 1 foot high. But it is a law of steam that its density is always equal to the pressure that it is raised under: remove then half the pressure, and the steam will expand into double the space, exerting a mechanical power equal to support half the original pressure. Place two tons upon the piston, and the steam will then only occupy the space of 6 inches; that being in strict accordance with the above named law.

(To be concluded in our next.)

RECENT AMERICAN PATENTS.

[Selected and abridged from Mr. Keller's Reports in the *Franklin Journal*.]

An improvement in Door-latches. *James M. Hoggan.*—This is for an improvement on that kind of mortise latch in which the bolt is thrown back by turning the knobs either to the right or left, the projections or levers on the spindle being located within an opening in the body of the bolt, and acting on the back face thereof. The alleged objection to the old plan, which it is the object of the present modification to remove, is the small extent of motion given to the bolt, or if not this, the great width required to be given to the opening, in the bolt to receive levers or projections on the spindle of sufficient length to give the required motion to the bolt. To remedy this defect, four cogs are made on the spindle above, two above and two below, and one above and one below in the space or opening in the bolt. The first cog above and below on the spindle are on the same plane, and act against the back face of the opening in the bolt, and the other two are on a plane further back and act on the cogs of the bolt. This arrangement of the cogs is necessary to admit of pushing back the bolt by turning the knobs in either direction; for when the upper cogs are in action, the lower cogs pass by each other, and *vice versâ*, which would not be the case if all the cogs were on the same plane. Another improvement is for adopting the spindle to doors of various thicknesses, by tapping the spindle for the reception of the knobs, which screw on, and providing a slot at each end, instead of a hole, for the securing pin.

Improvements in the Cotton Press. Jedediah Prescott. — The follower of this press is operated by means of two parallel levers jointed to the underside of it (one at each end) and to a carriage, that runs on truck rollers on the bed of the machine, and is worked by cords passing round pulleys and extending to a capstan. The ends of the box are let into grooves in the follower or platen of the press, and work up and down with it, and at the end of the operation they are lifted out of these grooves and liberated by two short levers that strike against projections on the frame—these levers are designated in the claim by the letter *x*. The lower edges of the sides of the box are jointed to the frame, and, when closed, are held in place by two bars, which are thrown up towards the end of the operation, by pins connected and moving with the platen.

Claim.—"What I claim as my invention, is—1st. The combination of the inclined parallel levers with the horizontal carriage and rollers, arranged and operated in the manner and for the purpose set forth. 2nd. The arrangement of the ends *d* of the box grooves in the platen, so as to rise and fall with the platen, and be liberated from it at the termination of the pressing. 3rd. The combination of the levers *x* with the platen, arranged and operated in the manner and for the purpose above set forth. 4th. The manner of disengaging the bars from the box, by means of the pins upon the ascending ends of the box, in order to throw open the sides of the box, to tie and remove the bale."

Improvements in the Tide Mill. John Gerard Ross.—The wheel is placed in a race, at one end of which there is a tide gate hinged to a wall beyond the end of the race and shutting against either side of the race; and at the other end of the race there are two current gates, one termed the "inner current gate," and the other the "outer current gate;" these are hinged to the ends of the race-way wall and shut against a pier placed beyond the end, and in a line with the middle of the width of the race-way. The current in passing along opens the "current gate," and after acting on the wheel passes out through the "outer current gate," and on the return tide the pressure of water closes this "outer current gate," which causes the current to pass round to that side of the tide gate opposite to that at which it entered on the rise of the tide, throws it against the opposite side of the race-way, acts on the same side of the wheel as on the rise of the tide and passes out through the "inner current gate." The dam walls are formed with pits open at the sides for the free ingress and egress of the water to act on floating caissons which sustain the wheel and always keep it at the required elevation. The shaft of the wheel (or wheels) is connected with the frame work of the mill by bars radiating from the axis of a cog-wheel, into which mash the cogs of the master wheel.

Claim.—"*First.* I claim as new, and of

my invention, the mode described of fitting the tide-gate, at one end of a race-way, formed by an inner and outer dam-wall, in combination with an outer current-gate, and an inner current-gate, at the opposite end of the race-way; the whole constructed and operating substantially as herein described.

Second. I claim the mode of forming the dam-walls with pits, open at the bottom, to receive and float the caissons that carry the water-wheel; and the combination therewith of the described means for regulating, adjusting, and directing the ascent and descent of the wheel or wheels, substantially as the same are described and shown herein.

Third. I claim the combination of the described mode of fitting the gates and wheel, and making them act together in the manner described herein."

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC., CAP. 65 FROM SEPTEMBER 24 TO OCTOBER 21, 1845.

Date of Registration.	No. in the Register.	Proprietors' Names.	Address.	Subject of Design.
Sept. 24	539	Andrew Bissett and James Woodclarke	1, Rodney Buildings, New Kent-road	Bachelor's oven.
25	540	Charles Lewis	Stangate House, Lambeth	Improved omnidirective shower bath.
29	541	Andrew Dacey	5, Red Lion-court, Christchurch, Spitalfields	Boethomonochier, or machine for assisting one-handed persons to feed themselves.
,,	542	Thos. Evans and Sons	Great Sherston, Wiltshire	Five-furrow drill for manure, turnips, and corn.
,,	543	Charles Powell	Smith's Buildings, Leadenhall-street, London	A form for grooved and seated bar iron.
30	544	Mac Dougall, Sambourne, and Bell	St. Paul's Churchyard	Collar Victorine.
Oct. 2	545	John Keyse	27, Crosby-row, Walworth-road	The Albert swimming apparatus and life-preserver.
4	546	Holker Meggison	Highfield, near Southampton	Cartridge case.
,,	547	John Robinson	Nos. 3, 4, and 5, Nassau-place, Commercial-road, London	Waistcoat.
,,	548	W. Rodenhurst	Market Drayton	Improved straw cutting engine.
6	549	Jas. Chadnor White	Tewkesbury	Harness tug.
7	550	William Allen	Morgan's-place, Liverpool-road, Islington	Philosophical corn and bunion shield.
8	551	Thomas Gibbons	18, Upper East Smithfield	Self-adjusting cot.
,,	552	Charles May	3, Curtain-road, Shoreditch	Screw cap for bottles, &c.
9	553	Charles Bray	14, Cranbourne-street, Leicester-square	Culinary vessel.
,,	554	Benjamin Nicoll	42, Regent Circus, Piccadilly	Shirt.
10	555	Geo. Bassett	341, Strand	Instrument for impregnating liquids with gases.
15	556	John Whitehouse and Son	87, Birchall-street, Birmingham	Letter clip and universal holder.
,,	557	Robert Marples	Carver-street, Sheffield	Brace head.
,,	558	William Jenkins	10, London-street, Fitzroy-square	Expanding and collapsing pianoforte case.
,,	559	Mark Frearson	14, Hanway-street, Oxford-street	Railway carriage disconnecter
16	560	Jones and Co.	Light House, 201, Strand	Fountain coffee-pot.
,,	561	Jno. Wm. Edgson	Etton, Northamptonshire	Dibbling instrument.
,,	562	Wm. Thos. Yates	1, John-street, Cambridge Heath, Hackney	A moveable ash pan for fire places with parallel bars for separating the cinders from the ashes.
17	563	W. C. Wilkins and M. S. Kendrick	Long Acre	The Carcel spirit meteor lamp.
18	564	Henry Holland	169, Darwin-street, Birmingham	Spring for the runner of an umbrella or parasol.
20	565	J. Dixon and Son	Hatton-garden	Watch protector.
,,	566	Stevens and Son	Darlington Foundry, Southwark-bridge-road, London	Semaphore signals for railways.
21	567	Francis Nalder	41, Cheapside, London	Glove.

THE ATMOSPHERIC RAILWAY SYSTEM.

There have been three experimental exhibitions during this week on a portion of the London and Epsom atmospheric railway, which has just been completed between the Dartmouth Arms and Croydon, and the success throughout has been complete.

First Day's Experiment.

The train consisted of ten carriages, (including that to which the piston is attached,) and its weight was upwards of 50 tons. Within a minute and a quarter of the piston entering the pipe, the speed attained against a strong head wind was at the rate of 12 miles an hour; in the next minute it rose to 18 miles an hour; and progressively increased to 25, 34, 40, and 52 miles an hour. The distance from the Dartmouth Arms to Croydon, five miles, was performed in eight minutes and three-quarters. The barometer in the piston carriage indicated a vacuum of 25 inches; and that in the engine-house, a vacuum of 28 inches.

Second Day's Experiment.

On one part of the journey this day we went a mile in 62 seconds, in an open carriage, without feeling any inconvenience. The Brighton railway is crossed by a viaduct, the ascent being with a gradient of 1 in 50, and in the middle of a curve of half-a-mile radius; up this incline (probably inaccessible to a locomotive engine from want of bite upon the rails) the trains went at full speed, the length of it being too short to affect the rate very sensibly, or make it necessary to apply extra power. The barometer ranged from 26 to 27 inches.

Third Day's Experiment.

On descending the viaduct towards Croydon, it appeared that the train would not be stopped in time by the mere application of breaks, and a valve in the piston was opened, which, allowing the air to rush into the vacuum in front, reduced the mercury in a moment from 27 inches to 12, and soon moderated the speed. The trains were 50 ton trains; when stopped at a station, two pairs of breaks were applied for about five-eighths of a mile, and rather more than two minutes were lost by every stoppage, the train being at rest for a quarter of a minute.

At each station, Forest-hill, and Norwood, and Croydon, there are a pair of 50-horse power engines to exhaust the air, but at present it is not found necessary to work an engine at the middle station.

The engines have been built by Messrs. Maudslay and Field, and are in every way worthy of the high reputation of their establishment for highly-finished and efficient workmanship.

ROTARY STEAM ENGINES.

The "satisfactory" Janus, (fitted with the Earl of Dundonald's rotary engine.)

The *Janus*, steam-sloop, during the week, has been making experimental trips down the Medway. The first was made on the 11th instant, the Earl of Dundonald and Captain W. H. Shirreff, superintendent, being on board. From opposite the dockyard to Upnor Castle the wheels revolved *about five times within the minute*, when a breeze sprung up, and her canvass was spread. She then went down as far as Gillingham-reach, the wheels revolving *about thirteen times within the minute*. It now appears that after all the trouble and expense of taking her machinery to pieces and reconstructing it, there is not any alteration in the speed effected since her last experimental trip. The general opinion that prevails is, that this craft is a total failure. — *Chatham Correspondent of the Times.*

The Novelty screw steamer, (fitted with Borrie's rotary engine.)

Malta, Sept. 24.

The *Novelty*, a steam bark, the first of a new line to run between Liverpool and Constantinople, arrived here from the former port late on the night of the 16th inst., *after a passage of twenty days!* She is commanded by Mr. Crowder, late of the Royal navy. This vessel is not only propelled by the screw, but is worked by a newly invented rotary engine, which the inventor expects will make a complete change in steam navigation. (?) The engine is two-thirds less in point of dimensions than an ordinary one of equal power, and its consumption of fuel is proportionately smaller. The entire weight of the machinery and boilers of the *Novelty* is only twenty-four tons. Her first attempt, however, must be considered a failure, as a heavily laden collier from Leith arrived here *the same day, after a passage of twenty-four days.*

We are informed that there are three more steam-boats in process of construction, at the present time, for the same company, to be built on the same principle as that of the *Novelty*, and that the result of the experiment is auxiously awaited. The *Novelty* proceeded on her voyage to Constantinople on the 18th inst.

LIST OF ENGLISH PATENTS GRANTED BETWEEN SEPTEMBER 25 AND OCTOBER 10, 1845.

Alexander Bain, of Hanover-street, Edinburgh, engineer, for improvements in electric clocks and telegraphs, part of which improvements are applicable to other purposes. September 25; six months.

Alfred Vincent Newton, of Chancery-lane, mechanical draughtsman, for certain improvements in machinery for manufacturing screws. (Being a communication.) September 26; six months.

Alfred Vincent Newton, of Chancery-lane, mechanical draughtsman, for certain improvements in machinery for manufacturing metal pipes or tubes. (Being a communication.) September 26; six months.

John Reed Hill, of 28, Stamford street, Lambeth, civil engineer, for certain improvements in atmospheric propulsion, applicable to water as well as land carriage. (Being a communication.) October 2; six months.

George Roberts, of Wells-street, Cripplegate, miner, for certain improvements in the construction of lamps for illuminations. October 2; six months.

John Kershaw Ramsbottom, of Lancaster, cotton-spinner, for certain improvements in machinery or apparatus used in the preparation of cotton, or other fibrous substances, for spinning. October 2; six months.

Frederick Rosenborg, of Kingston-upon-Hull, gentleman, and John Malam, of the same place, gas manufacturer, for certain improvements in or apparatus for watering or manuring and drying trees, plants, seeds, and roots, and for accelerating and improving the growth and produce of trees, plants, seeds, and roots, October 2: six months.

Alfred Hall, of Coxsackie, America, brickmaker, for certain improvements in machinery or apparatus for making, moulding, or manufacturing bricks, tiles, and other articles, from earthy or plastic materials. October 2; six months.

George Daniel Bishopp, of Egbaston, Warwick, civil engineer, for improvements in certain engines, or machines, used for obtaining mechanical power, and for raising and impelling fluids. October 2; six months.

Robert Clark, of Newburgh, ship painter, and Alexander Pirnie, of the same place, ship's smith, for certain improvements in steering vessels. October 2; six months.

John Simpson, of Langton Rectory, York, clerk, for certain improvements in obtaining and applying motive power. October 2; six months.

John Hale, of Leicester-square, Middlesex, Esq., for certain improvements in guns. October 2; six months.

Graziana Conté, of Regent-street, Middlesex, merchant, for improvements in machinery for cutting, carving, and sculpturing marble, stone, wood, and other like substances, being a communication. October 3; six months.

Moses Poole, London, gent., for improvements in rails for railways, being a communication. October 6; six months.

Gabriel Hippolyte Moreau, residing at 18, Boulevart Bonne Nouville, Paris, gent., for an improved steam carriage. October 6; six months.

Augustus Julien Van Oost, of Genbruge, near Ghent, but now of Osnaburg-street, Regents park, for improvements in treating seed, and in preparing materials used for fertilising land, and for aiding vegetation. October 6; six months.

Thomas Russell Crampton, of Southwarks-quare, Surrey, engineer, for improvements in locomoivee engines and railways. October 6; six months.

Thomas Howard, of the King and Queen Iron-works, Rotherhithe, Surrey, iron manufacturer, for improvements in rolling iron bars for suspension bridges and other purposes. October 6; six months.

Joseph Quick, of Sumner-street, Southwark, engineer, for improvements in steam engines. October 9; six months.

John Lake, of Apsley, Herts, civil engineer, for certain improvements in propelling. October 9; six months.

Isaac Hartes, of Rosedale Abbey, York, farmer, for certain improvements in machines or machinery for rowing, sowing, and manuring land. October 9; six months.

Edmund Morewood, of Thornbridge, Derby, merchant, and George Rogers, of Stearndale, gent., for improvements in the manufacture of iron into sheets, plates, or other forms, in coating iron, and in preparing iron for coating and other purposes. October 9; six months.

Alexander Parkes, of Birmingham, artist, for improvements in coating or covering certain metals with other metals, and metallic alloys, and for ornamenting the surface of various metallic articles. October 9; six months.

Thomas Wood Gray, of Workworth-terrace, Commercial-road, plumber, for improvements in ports and apparatus for opening and closing ports of ships or other vessels, also applicable in opening and closing windows and other instruments having the like movements. October 9; six months.

Henry Francis, of Wardour-street, civil engineer, for improvements in the manufacture of gas. October 9; six months.

Edward Morgan, of Tenby, Pembroke, gent., for an improved envelope for letters. October 9; six months.

Edward Patrick Emerson, of the city of Dublin, doctor of medicine, for improvements in the manufacture of paints, pigments, cements, and other plastic compositions, and in the machinery or apparatus to be used in such manufacture, parts of which improvements are also applicable to the manufacture of artificial stone and marble. October 9; six months.

Thomas Hollingsworth, of Birmingham, cigar merchant, for a certain improvement or improvements in the construction of cases for holding cigars. October 9; six months.

Joseph Edward Judson, of Ashton-under-Lyne, Lancaster, saddler, and Edward Banton, of Walsall, Stafford, commercial traveller, for a certain improvement, or certain improvements in covering rollers used in spinning cotton and other threads, also in covering mill straps. October 9; six months.

David Wilkinson, of Potters' Pury, near Stoney Stratford, gentleman, for improvements in obtaining motive power. October 10; six months.

Edward Lesley Walker, of Foley-place, professor of music, for improvements in pianofortes. October 10; six months.

Joseph Clishild Daniell, of Tiverton mills, near Bath, for improvements in dressing and finishing woollen and other cloths. October 10; six months.

George Fergusson Wilson, of Belmont, Vauxhall, gentleman, George Gwynne, of Putney, gentleman, and James Pillans Wilson, of Belmont aforesaid, gentleman, for improvements in the manufacture of soap. October 10; six months.

Alexander Jamieson, and John Frederick Lu[...] holm, of Tothill-street, Westminster, manufacturing chemist, for improvements in dressing ores requiring washing. October 10; six months.

John Whitehead, of Leeds, for improvements in machinery for combing, hackling, and straightening wool, flax, tow, and other fibrous substances. October 10: six months.

[*For continuation see cover of Monthly Part.*]

Errata.—In the account of the experiments w[ith] the *Bee*, given in our last Number, p. 270, for "[to] ensure *more* blowing off," first col., line 9 from [the] bottom, read "to ensure *none* blowing off;" and [for] "the paddles were *dismounted*," read "the padd[les] were *disconnected*."

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

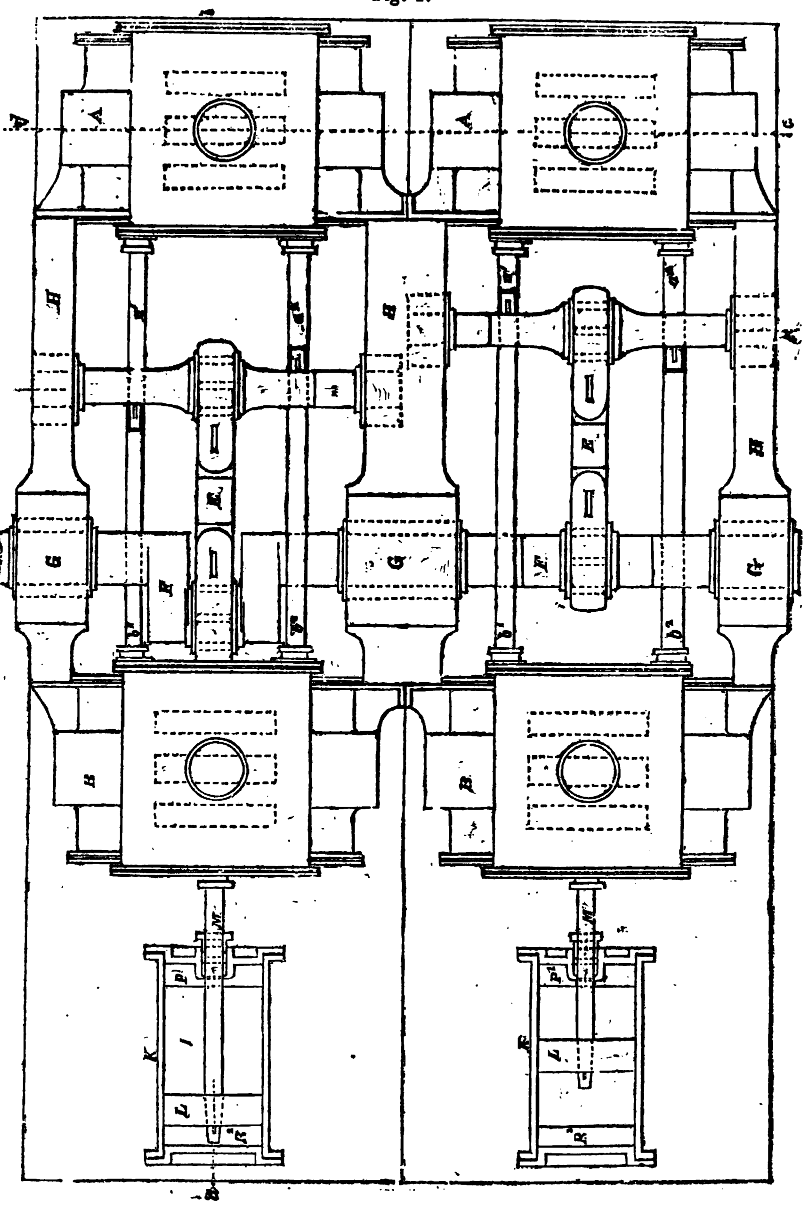
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1160.] SATURDAY, NOVEMBER 1, 1845. [Price 3*d*.

Edited by J. C. Robertson, No. 166, Fleet-street.

Fig. 1.

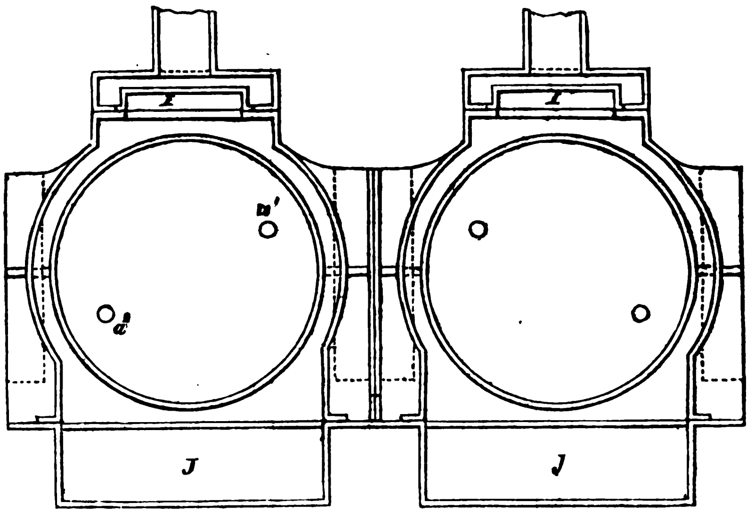


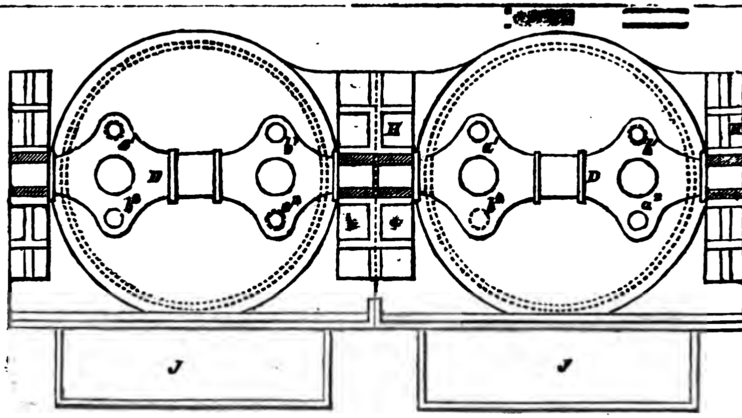
[illegible] AND FIELD'S PATENT HORIZONTAL DOUBLE CYLINDER ENGINE.

MESSRS. MAUDSLAY AND FIELD'S PATENT HORIZONTAL DOUBLE CYLINDER ENGINE.

[Patent dated April 24, 1845; Specification enrolled October 24, 1845.]

Fig. 3.

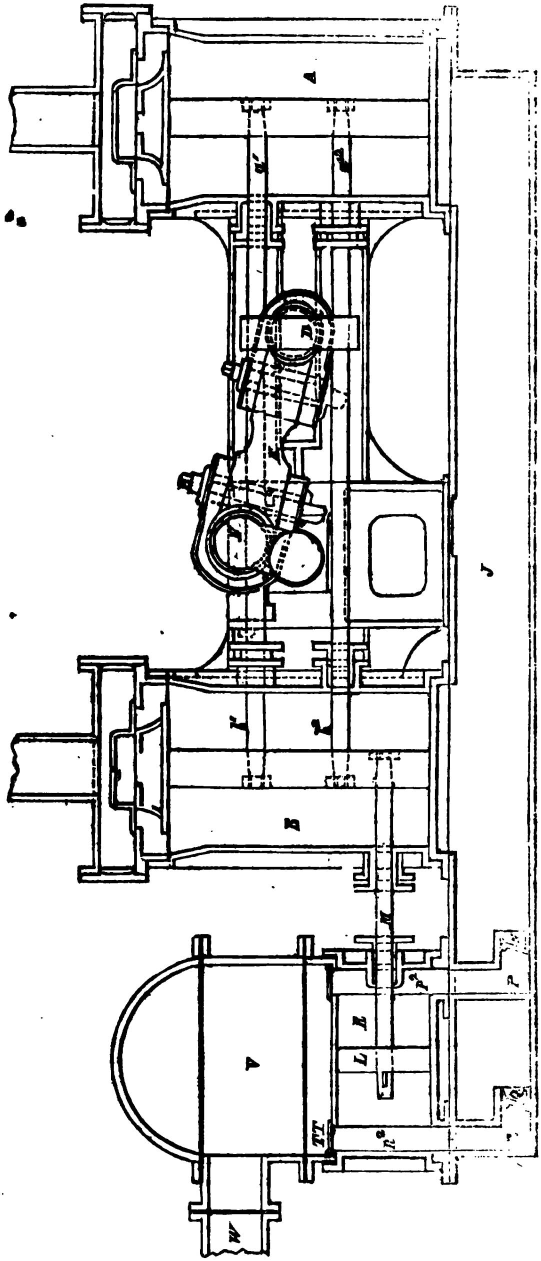




The objects aimed at obviously in the construction of this engine have been twofold—*first*, to adapt it to marine screw propelling; and, *second*, to enable it to be placed at the very bottom of a vessel, not only close to its work, but out of the reach of damage from shot. Both these objects have, we think, been very cleverly and successfully accomplished.

The engine has two steam cylinders, the joint areas of which are equal to the area of a cylinder of ordinary dimensions; that is to say, supposing the engine were required to be of 100 horses-power, the cylinders would each be of an area equal to a portion of the 100 horses-power, as for example, the two cylinders might be of 50 horses power respectively, or of 60 and 40, or of 70 and 30. These cylinders are placed horizontally, end to end in the same straight line, but with space enough between them to allow o

Fig. 2.



the movement to and fro of their respective piston rods and appendages. The piston of each cylinder has two rods, (instead of one, as usual,) and the two pairs

of piston rods are connected to one common cross-head, which acts through one connecting-rod on one crank attached to the propeller shaft.

Fig. 1 of the engravings represents a top plan of a pair of engines of this description as fixed in a steam vessel, and applied to a screw propeller; fig. 2 is a transverse elevation on the line *a*, *b*, of fig. 1; fig. 3 is an end view on the line *c*, *d*, of fig. 1; and fig. 4, a transverse view on the line *e*, *f*, *g*, fig. 1. A, B, are the two cylinders; a^1, a^2, the two rods of the piston of the cylinder A; and b^1 b^2 the two rods of the piston of the cylinder B. D is the cross-head, to which the two pairs of piston-rods are attached. One rod of each pair is placed above the cross-head, and the other below it, and the four rods are so placed in this respect, in relation to one another, that the two rods which are above the cross-head shall be diagonally the opposite of one another, and the two rods which are below it, the like. For example, if a^1, of one pair is placed above the cross-head, then b^2 of the other pair must be also above it, and a^2 and b^1 be the two rods which are placed below it. The cross-head D, has a bearing in the middle of it for the connecting-rod E and prolongations, one at each end, which serve as a guide for the rod. F is the crank on the propeller shaft, having bearings, G G, in the frames, H H, which serve both to connect the two cylinders, and as guidesfor the cross-head. I I are side valves for regulating the inflow and outflow of the steam to and from the cylinders, which may either be connected together and worked by one eccentric, or may be worked independently, each by means of a separate eccentric. J J are the condensers.

The air-pumps are also horizontal, and are fitted and worked in the manner shown on the left-hand side of fig. 1 and fig. 2; where the pump is represented as of the double-acting sort. K is the barrel of the pump; L, the piston, or plunger; M, the piston-rod, which passes through a stuffing-box in the outer cover of the cylinder B, and is attached directly to the piston of the steam cylinder, so as to derive its motion therefrom. N is the lower foot valve at the end of the passage P, which communicates with the condenser, and leads to the space P^2, on one side of the piston or plunger. Q is another foot valve at the end of the passage R, which communicates, in like manner, with the condenser, and leads to the space R^2 on the opposite side of the plunger. T T are discharge valves, placed on openings over the space R^2, and U a similar discharge valve placed on an opening over the space P^2. V is the cistern, or hot-well, and W is the discharge pipe for the ejection of the air and water overboard.

When the air-pump is single, acting, (which, however, Messrs. Maudslay and Field do not consider so suitable as the double-acting pump just described,) it is made with valves on the plunger as usual.

ON THE WORKING OF STEAM EXPANSIVELY IN THE ROYAL STEAM NAVY. BY COMMANDER HOSEASON.

[Concluded from p. 285.]

"Keeping this in view, that steam only loses half its power when expanded double the space, turn to the enclosed diagram of a cylinder: here I will consider the pressure at the top of the descent of the piston (as represented by Lardner in page 161) at 2,240 pounds; now as long as the steam continues to flow from the boilers or steam-chest the pressure is *constant* and *uniform*, therefore continues equal to 2,240: but, after it has arrived at half its descent, a valve is closed by the working of the engine, which cuts off any further communication between the steam-chest and cylinder; all future power exerted must arise from the expansive quality of the steam.

"I have, however, stated above that it only loses half that power when expanded into double the space; consequently, when arrived at the bottom of the cylinder, it still exerts a power equal to half its original pressure, which in numbers shows 1,120; but that is the *terminal* pressure, not the *mean*, to obtain which I will divide the second half of the cylinder into ten equal parts, and multiply 2,240 by 10, and divide it by 11, 12, 13, &c., this will give me the loss at each succeeding division of the descent; these added together and divided by 10 give 1,498 pounds as a mean pressure, which subtracted from 2,240 leaves 742, that being barely the third of the half; but the third of the half is the sixth of the whole; consequently I have saved half of the steam, therefore half of the fuel, and only lost one-sixth of the effective pressure on the piston. I have, however, stated that half the quantity of steam in the cylinder, (called '*wire drawn*') whose pressure is *constant* and *uniform*, and as such equal to one half, loses but $\frac{2}{3}$ of the velocity in accordance

with the law of the squares; then, should I require to know what one-sixth will lose, I have but to say as $\frac{1}{2}$ gives a loss of velocity of $\frac{2}{8}$ what will $\frac{1}{6}$ give? The answer is, $\frac{1}{14}$ nearly.

"Here then is perceived the immense advantage to be derived from working steam 'expansively.'

"Let me now recapitulate how these proportions bear to each other; by cutting off at half stroke, I lose but one-sixth of the effective pressure on the piston; that equals one-fourteenth of velocity; but half the steam has been saved, which equals half the fuel, in accordance with the law 'that the quantity of steam generated, is the direct proportion of fuel consumed.' Suppose then the maximum velocity of a steamer to be eleven miles per hour, the loss of one-fourteenth would only reduce the rate of steaming $\frac{7}{10}$ of a mile; that would still leave the velocity $10\frac{3}{10}$ knots; so, if the expenditure of coal *without* the '*expansive gear*' was 20 cwt. to the hour, I shall obtain for 10 cwt. the above named velocity, $10\frac{3}{10}$ knots. But it is evident, if the law of the squares be true, I can reduce half upon this again with only a sacrifice of two miles.

"Then I come to this inevitable conclusion, that, by 'cutting off at half stroke' and keeping in view the law of the squares, I obtain 32 instead of eleven miles for every ton of coals; and, supposing such velocity possible to be averaged, the time in which a thousand miles would be traversed stands 125 to 91 hours, with an expenditure of $31\frac{1}{4}$ instead of 91 tons of coal, with the use of one boiler for 125 hours in lieu of four boilers for 91, which is as 125 bears to 364.

"Throughout, I have considered the steam cut off at half stroke, merely to keep together a connected chain of reasoning; but a still greater saving will take place by cutting off at a quarter.

"Great confusions of ideas seem to be in some men's brains with respect to expansive steam. They certainly have laboured under the delusion that it is essential to raise steam to a high pressure to work it expansively. The loss is relatively the same, viz., less than one-sixth of the power, whatever pressure the steam may be raised under; for steam loses less than one-sixth by calculation of mean pressure, and *no more* when expanding into double the space. I have said less than one-sixth by calculation; for by the 'Indicator,' that beautiful invention, and only sure test, it is found, that, 'while half the quantity of steam is saved, the loss of power by the engine is *less than an eighth*;' this was the result of an experiment on board the *Commodore*, a fine 700 ton steamer.—*Robinson on Steam*, p. 161.

"Of all the beautiful discoveries of the great Watt, none I think more astonishing than that of the 'expansive system.' I arrive at this conclusion from perceiving the difficulty which even men of ability show, 22 years after the decease of this wonderful man, in defining what he has discovered; nor do I clearly perceive by what chain of reasoning he arrived at so happy a discovery; all other parts of the engine are described with the greatest facility, but this brings us fairly to a stand. If you question my judgment on this head, read Lardner attentively, whenever he treats on the 'expansive system,' more particularly in his seventh edition, page 235. Capt. Otway flounders most delectably in the vain endeavour to make that intelligible to others which he does not understand himself; in his definitions and illustrations he is equally unhappy. I would be understood only to make these affirmations when either seeks by words to explain their ideas; for it is remarkable enough, that they both are sure to negative their own calculations; as their definitions ever contain something more than is proved by the figures. A few simple facts oftentimes speak more clearly to the understanding than the most astute reasoning upon them. Sixty-one years have elapsed since the discovery of the expansive action of steam, yet we find Government have but three vessels fitted with the necessary gear out of the thirteen steamers in the Mediterranean;* these three are *Stromboli*, *Vesuvius*, and *Hecate*. I deliberately stated in our mess, that the Captain of the first-named ship did not understand the advantage to be derived from the expansive system; and I arrived at this conclusion from the perusal of his own work. I need hardly tell you that my opinion on this head gathered but little strength from a fact which I subsequently discovered on visiting the engine-room of the *Stromboli*. When in conversation with the engineer, I said, 'You are not fitted with expansive gear, I suppose?' 'Yes,' he replied, 'we are.' 'Indeed!' I rejoined, 'now I shall learn what I want. How many revolutions in smooth water do you obtain, when cut off at half stroke; and what velocity does that number of revolutions give you?' 'I don't know,' was his answer, 'we tried it but for an hour, and then Capt. Williams gave it up.' I said nothing more, for I had heard enough.

"The *Vesuvius*, I have also been told, has

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* I have since discovered I am wrong as to the number; but, were I to revise this paragraph, I could demonstrate to the satisfaction of all parties, hat I have not made the most of my case.

never been able to make it work. The *Hecate* has, but only for two months out of fourteen, though she has rarely been in harbour. My informant for this fact is the officer that keeps the steam log. If it be pleaded that the gear is out of order, why is it not properly represented? for it would amply repay Government to send a fit person from England to set them all in order. But the truth I conceive to be, is, that its value is not clearly understood, consequently not justly appreciated.

"In the fairness of argument it is necessary for me to state an objection that has been raised against me, for the same is likely to strike your mind. It had occurred to me previously, but I could not at that period find any way of getting rid of such difficulty; and therefore adopted my old plan of falling back on the fact which was adverse to this apparent deduction of reason. The objection is this, that when I run a steamer on half fuel, I throw upon that half all loss by condensation, friction, working the pumps, &c. Captain Otway was not the man to help me in this difficulty; for he quietly jumbles them all together, and then estimates it at half the entire pressure of the steam raised in the boiler; so does Lardner, 7th edition, page 293. A pretty loose way this is for estimating the effective pressure on the piston; but the 'indicator' once more comes to my aid and solves all doubt.

"These are the results of two experiments, the first, the *Commodore;* second, the *Wilberforce*. 1st. In this instance, the mean effect of the force is, for steam 4·52 lbs., and vacuum 11·80 lbs.; total, 16·32 lbs. Total of the force in the boiler and condenser being 20¾ lbs., and the maximum force exerted in the cylinder being 19½ lbs.'

"2nd. The total force in the boiler and condenser in the *Wilberforce* was 19¾ lbs. per square inch, and the mean effect was 15·35 lbs.; the maximum force in the cylinder being 17 lbs per square inch.'—*Robinson*, page 159.

"I see that the last-named gentleman estimates friction and working pumps at 2 lbs. the square inch; this may be well enough when working at a maximum; but I object most strenuously against the same estimate for my poor half; as I have always been led to understand that friction decreases considerably at the lesser velocity. Does not this prove how cautious we ought to be, ere we oppose a fact by a theory?

"I had stated, some months previous to the *Great Liverpool's* piston being broken, that, were she to steam from Malta to England on half power, seven miles an hour ought to be her average. I deduced this *not* from her maximum velocity, but from the time she had absolutely taken to perform the voyage from Malta to England, and *vice versa;* the distance is done, in nineteen instances out of twenty, in ten days; which gives, on an average, nine miles to the hour. My reason for taking the *Great Liverpool* into consideration, arose from the remarkable precision with which her voyages, both out and home, have generally been performed.

"I wish, however, to remind you, Sir Graham, that any vessel steaming but with one piston does so at a mechanical disadvantage; for there is a loss of power in passing over the dead points. She would have steamed faster working both cylinders, with valves half closed; for, the cranks being placed at right angles to each other, when one is at the maximum as to power, the other is at the minimum; this proves that, had she not laboured under this disadvantage, she would have performed the voyage in less time than I deduced from the average. It was denied to me previous to this case that the law of the squares held good at different velocities; some admitted that it might be true enough in smooth water, but not otherwise. This assertion on their part showed an entire ignorance of the laws of motion; but all reasoning was vain; I failed to convince: when once an error has taken full possession of some men's minds, the very absurdity of the doctrine seems to confirm them in the belief. Should they hold to it now, I simply ask whether they mean to assert, that the *Great Liverpool* steamed neither more nor less than 7 knots 2 fathoms every hour in the twenty-four for thirteen days? as I conceive the most strenuous opponent will hardly answer in the affirmative, I therefore state that it appears to me evident that she must have occasionally fallen below and risen above it. Her maximum velocity tells me what her half power could not have exceeded, but I cannot say without an inspection of her logs what was her lowest speed; I trust, nevertheless, I have established enough to satisfy even the most incredulous.

"Following up a rule, which I have laid down for myself of not considering any point proved, without I have brought some strong facts in support of my theory, I shall now produce two powerful examples of the advantage to be derived from working steam *expansively;* these cases are well worthy of consideration, for as yet they appear to have excited no particular attention, except it be to have had their accuracy pretty distinctly called in question by a certain worthy gentleman, who, finding them a little above his comprehensive

faculties, deemed it most philosophic to doubt their infallibility, without even a moment's consideration.

"The cases to which I allude are the *Atalanta* and *Berenice*, two of the East India Company's steamers; the former left England for India in December, 1836, and the latter in March, 1837.

"My attention was drawn to the logs of these vessels from having perused a letter in the *Nautical Magazine* signed 'Mercator.' As this gentleman appears to be possessed of a tolerable knowledge of steam, I think his observations worthy of consideration; and they will demonstrate most satisfactorily how imperfectly the advantage to be derived from the expansive action of steam had then been appreciated; and it is not the less remarkable that this letter was called forth by his having perused an account of the proceedings of the 'British Association;' during which proceedings the names of both the vessels were mentioned, with their consumption of fuel, and the discussions arising out of the citation of this immense diminution of fuel passed without a single individual hinting at the cause. Doctor Lardner clearly (by a question asked) proves his total ignorance of the matter, as also did the gentleman who responded to him. I will now give the quotation.

"'A perusal of the account given in your number of this month on the proceedings of the British Association, on the subject of steam navigation, induces me to make some further observations on *sea-going* steamers. I am also prompted to this by seeing in the *Nautical* the logs of the Honourable East India Company's ships *Atalanta* and *Berenice;* as it appears to me there must be some gross mistake as to the consumption of fuel stated to have taken place on board them, page 790. Again: It seems difficult to suppose errors, where the quantity of coals consumed in the gross is given, the time of being under steam, and the distance run; but, if there be no mistake, all I can say is, that they are the very best performances of steamers ever yet heard of; and I would recommend the makers of the machinery to favour the public with an authentic statement of success which would undoubtedly redound so much to their credit and future profitable employment. In the mean time I must entertain doubts upon such very extraordinary statements.'

"I should indeed think it difficult to suppose errors where the quantity of coals *consumed in the gross* is given! and for that reason did not allow myself to be hurried into any conclusion. I felt there must have been truth in the logs, though I might fail to discover to what cause so great a saving was to be attributed; but an idea flashed instantly to my mind that the *expansive gear* had been called into requisition. I looked in vain for the working of the same log of the *Atalanta*, though I could not help remarking how small was her consumption, and steady the expenditure, she rarely exceeding 12 cwt. to the hour. I afterwards turned to the log of the *Berenice;* not a word was said on the subject in her run from Falmouth to Teneriffe; but from Teneriffe to Bonavista I read the words: 'Monday the 27th of March, 1 P. M. set on the expansive valve:' and twice or three times the same is repeated. The consumption of coal being the same before the mention of this fact as after, I infer that she left England working *expansively*, and attribute the omission to gross ignorance or neglect. The *Atalanta's* consumption being on the whole, less than that shown by the *Berenice* in proportion to her horse power, leaves hardly a doubt that she was also steaming under the same advantage. But look at this interesting statement that follows: 'Tuesday, 28th of March, 1 P. M., put off the expansion valve; increase of speed one mile per hour. At 2 set on an expansion valve.' The velocity shown in the column of knots and fathoms is 10 miles before the expansion valve is put off, 11 afterwards. Now what did I compute the loss to be when 'cut off at half stroke' with the same velocity? Why at $\frac{7}{10}$ of a mile! So then, theory and practice go hand in hand excepting the small pifference of $\frac{3}{10}$ of a mile out of eleven; this I cannot help conceiving, is pretty much to the purpose; and it is as well to mention, that the wind was a *light* breeze from the N. E. course of S. W.

"The consumption of coal, it is but just to say, something more than it ought to be when 'cut off at half stroke;' for a vessel of the *Berenice's* horse-power 230. But I perceive the quality varies considerably, and I have a right to conclude that, unless they permitted steam to run to waste, the consumption would have been double had she not used the *expansive gear*. I am justified in arriving at this conclusion from her subsequent voyage, when, without some previous malversation, the superiority of the coal is made evident. The following is the abstract: 'Voyage Bonavista to Fernando Po. Total consumed 157 tons 3 cwt. average per hour 11 cwt. 76 lbs. Average per horse-power 4¾ lbs. distance run by log 2,273 miles; time employed 269 hours or 11 days 5 hours, average rate $8\frac{4}{10}$ miles per hour or 202 per day.'—*Nautical Magazine*, page 606.

"This consumption is one-half less than the best engines not working *expansively* can show.

"I have shown two ways by which a saving may be effected; the first by simply closing the throttle valve, and reducing the necessary number of fires; the other by working *expansively*. The evident advantage possessed by the latter mode points out that the former ought only to be resorted to by steamers which are not fitted with the *expansive gear*.

"I will now call your attention to the manner in which steamers have heretofore, with rare exceptions, been handled at sea; and which I declare to be in direct violation of the dictates of common sense. I question not my assertions on this head will also be denied; but by the blessing of Providence, unless they falsify their own logs, I will make good my charge; let them so stultify themselves, if they please; I heed not, but shall take particular care that such conduct be brought under the consideration of the Ephori, to be dealt with according to its merits.

"Were I to write with more warmth, I could show sufficient reason; for as yet, any attempt on my part to elicit information has been met both with ridicule and contempt; so painfully have I felt this in some instances, that I have refrained from visiting the engine rooms, and asking any questions, though urged by the strong necessity of obtaining certain information, ere I expressed a decided opinion; and was therefore driven to the only alternative of wading through entire works, when one single reply to a question would have solved all doubt. These charges I do not prefer against the junior classes alone, for some palliation might be found for their folly, but when men high in rank in the service hope to deter me by such speeches as this, what can I think? 'I assure you, you are quite mistaken: it is impossible to reduce the consumption of fuel, and by that means add to the general efficiency of steamers; for my attention, with all the advantages of situation,—of command, has been directed to it for years without effect. With what show then of reason can your expectations be founded?' Such arguments, being addressed to one endowed with a naturally indomitable temper, served only to stimulate, but could not deter.

"The case to which I allude is where full power is kept up, steaming against a head sea; when it is evident, from the number of revolutions, that half the steam must be running to waste. This is a contest between folly and nature, therefore not difficult to divine which must be the victor. All seem to consider it essential to keep full power on to make any head way; but the pressure is a constant quantity, and if the piston does not descend the steam must escape somewhere; at times, however, it will act to the injury of the engine; for, should the wheels momentarily be freed by the vessel's sending, they will revolve with a speed even above the number that imparts the maximum velocity, and when they are again immersed receive a check that reduces their revolutions to less than one-half.*

'The watchful seaman whose sagacious eye,
'On sure experience may with truth rely;
'Who from the reigning cause foretells th' effect,
'This barbarous practice ever will reject.'

"I wish to record the following opinion, but shall not support it by argument, as my judgment has been formed on a careful consideration of a number of secondary causes which, taken separately, would fail to convince:—The greatest exertion of power does not at all times impart the greatest velocity; decrease your power, and you will, against a head sea increase the velocity!

"As I have taken some liberties with the works of Doctor Lardner and Captain Otway, I think it but right to acknowledge, that to those gentlemen, in conjunction with Hugo Reid, I am indebted for such information as was essentially necessary to enable me to carry out the above reasoning."

The Oregon is the name given to a steam-boat recently launched at New York, which is 10 feet longer than the *Great Britain*. She is about to be placed on the New York and Providence station.

Locomotive Manufactory at St. Petersburgh.—There exists in the capital of Russia an immense establishment of the above description, belonging to Messrs. Eastwick and Harrison, of Philadelphia, who have entered into a contract with the Russian Government to furnish all the machinery necessary for the construction and working of the vast lines projected in the whole empire. They employ at St. Petersburg not fewer than 3,000 workmen. To keep in good order this congregation of men, composed of Americans, Germans, Englishmen, and Russians, a company of soldiers is always stationed at the manufactory, and a special body of police is appointed to attend there. Men of turbulent conduct, if foreigners, are dismissed at once on any grave contravention of the regulations; and if Russians, they are tied up to a triangle and whipped with the knout. Messrs. Eastwick and Harrison have several times protested against this mode of punishment but unavailingly.

Submerged Side Propellers.—We observe in the last American papers, a notice of the launch of a steam-packet ship, called "*The Virginia*," which is stated to be fitted with submerged wheels, one on each side, near the keel, with engines of from 60 to 70-horse power. The vessel is 150 feet in length, 23 feet 10 inches in breath of beam, has four masts, and will carry 353 tons of goods: and, on an experimental trip, before the masts were rigged, with a full cargo, she averaged nine miles and a half per hour. We presume the wheels are on the horizontal plan, and similar to those lately patented in England by Mr. W. H. Taylor.

* Were that beautiful invention, called the Archimedean Screw, more justly appreciated, many of these objections would necessarily vanish.

[We are indebted to the same obliging correspondent at the Naval College, whose letter we published two weeks ago, for the following more complete statement of the experiments mentioned in that letter.—Ed. M.M.]

No. of Experiment.	Date of Experiment.	Height of Steam Gauge.	Revolutions per minute.	Consumption of Fuel.	Water evaporated from the Boiler.	Height of Barometer. Engine.	Height of Barometer. Weather.	Degree of Injection.	Temperature of Condenser.	Temperature of Sea Water.	Temperature of Engine Room.	Mean Pressure. Indicator Diagram.	Mean Pressure. Dynamometer diag.
									Degs.	*Degs.*	*Degs.*	*lbs.*	*lbs.*
(A) 1	22nd Sept. (With paddles.)	7	16	.. ..	90 gallons in $1\frac{1}{2}$ hours	27	30	3	100	60	82	17·68	629·354
(B) 2	23rd Sept. (With paddles and expansion gear.)	1st step 7	16	.. ..	.. ..	$27\frac{5}{8}$	30·13	3	98	..	..	17·612	612·954
		2nd of cam 7	$15\frac{1}{2}$	.. ..	.. ..	$27\frac{3}{8}$	30·13	$2\frac{6}{10}$	98	..	..	17·355	592·031
		3rd „ 7	14	.. ..	.. ..	$27\frac{5}{8}$	30·13	$2\frac{4}{10}$	99	..	..	15·812	501·885
		4th „ 7	13	.. ..	.. ..	$27\frac{1}{2}$	30·13	2·25	98	..	..	14·104	471·592
		5th „ 7	12	.. ..	.. ..	$27\frac{3}{4}$	30·13	2	99	..	..	12·333	378·95
(C) 3	25th Sept. (With paddles.)	1st hour 5	15	.. ..	.. ..	$27\frac{1}{4}$	29·85	$2\frac{3}{4}$	98	58	58	..	..
		2nd „ 5	15	140lbs. in 2 hours	108 gallons in 1 hour 40 minutes	$27\frac{1}{4}$	29·85	$2\frac{3}{4}$	98	58	65	..	584·760
(D) 3	6th Oct. (With screw.)	5	26	205lbs.	.. ..	$27\frac{3}{8}$	29·84	$3\frac{1}{4}$	98	60	69	16·729	523·05
(E) 4	8th Oct. (With paddles.)	7	$16\frac{1}{3}$	.. ..	.. ..	$27\frac{3}{8}$	.. ..	3	98	..	..	18·5	704·891

REMARKS.

(A) This trial was made with a short hawser; that is, the vessel was hooked on very near to the dynamometer.

(B) This trial was also made with the vessel close to the dynamometer.

(C) This trial was also with the vessel close to the dynamometer; Grant's fuel in use; $3\frac{1}{4}$ gallons of jacket water produced in the two hours' experiment. The steam was maintained at 5lbs. to insure none blowing of.

(D) This trial was made with the vessel hooked on to the dynamometer by a long hawser, it being considered against the screw to have the vessel too near the dynamometer. Grant's fuel in use; steam maintained at 5lbs. Tried, same day, both paddles and screw in gear at the same time, screw going a-stern, paddles a-head; paddles overcame the effort of screw pressure by dynamometer 317·27lbs.; 14 revolutions of engine; screw multiple 4 to 1 of the engine.

(E) This trial was made with the same length of hawser as the screw, that is, with the vessel at the same distance from the dynamometer.

Mem.—The greatest pressure given off by dynamometer with screw was 539lbs.; this was with steam at 7lbs. Revolutions of engine 28; barometer $27\frac{3}{8}$. The same length of hawser gave, with paddles, 704·891.

[During the last Session of the Institution of Civil Engineers, a very valuable paper by the President, Sir John Rennie, was read, containing a historical and descriptive account of the Ancholme Drainage in the county of Lincoln—a most successful, but prodigiously protracted work, no less than 556 years having elapsed since it was first commenced. The modern and most important portions of the works have been completed under the direction of Sir John Rennie, assisted by Mr. Adam Smith. After the reading of the paper the following discussion on it took place.]

Mr. J. Oldham bore testimony to the success of the works of the Ancholme drainage, in the beneficial effects they had produced in the district.

Sir John Rennie said, it would be observed that in the paper he had brought prominently forward, some leading principles of drainage, which he thought were very important.

These were, 1st. The formation of "catch-water" drains, which separated the highland from the lowland waters, and conveyed each to independent sluices, at the lowest practicable outfalls. This system was, he believed, first practised by the late Mr. Rennie, about the year 1801, in the Witham drainage.

2nd. The straightening, deepening, and general improvement of the main river, separating, as much as possible, the navigation from the drainage; and—

3rd. The formation of over-fall weirs and reservoirs, for arresting the sand and mud, and preventing the drains from being choked.

The advantages of these plans must be evident, particularly for a flat district, surrounded by high lands. He was of opinion, that the defects complained of in the Bedford level, might be attributed, in a great degree, to the neglect of these principles, and the continuance of the old Dutch plan, of simply cutting a series of straight drains to the nearest point in the river, without sufficient regard to the outfall, where only as much of the water was discharged, as was allowed by the time the sluice gates could be permitted, on account of the tide, to remain open. This plan alone was, he believed, still pursued in Holland. The attempts to drain the Pontine Marshes, under Pius VII., had been conducted on that principle, and even M. Prony, who was sent to Italy by Napoleon, for the purpose of reporting on the drainage of those marshes, made no other suggestion.

It had been asserted, that the Carr Dyke, which was constructed at the foot of the high lands between Peterborough and Lincoln, had been intended, by the Romans, for a "catch-water" drain and for a canal; but there was not any distinct evidence of the fact.

The works of the Nene Outfall, which were executed under Mr. Telford and Sir John Rennie, had cost about 160,000*l.* By that great work, the low-water mark had been lowered 10 feet 6 inches, and in conjunction with the North Level drainage works, which were executed under Mr. Telford, nearly 200,000 acres of land were most effectually drained, which, previously to that time, had been almost without cultivation. A further example of the effect of drainage, might be given, in the Thorney estate, of 20,000 acres, belonging to the Duke of Bedford. It was stated, that at times, previous to the drainage, scarcely any rent had been paid; but now, in consequence of the improvement of the land, from the system of drainage, towards which his Grace had contributed about 100,000*l.*, an annual rental of nearly 25,000*l.* was paid. The navigation of the Nene up to Wisbeach, was also so much improved, that large vessels now arrived there, and the trade had been nearly trebled. At Sutton Bridge, about eight miles below Wisbeach, where previously, only moderate-sized colliers could arrive, even at spring tides, vessels of nearly 700 tons burden could now be brought up, at ordinary spring tides. The flow of the tide, which formerly seldom exceeded between 11 feet and 12 feet, now attained a height of upwards of 21 feet, besides securing at low water a depth of between 5 ft. and 6 ft. in the channel down to the sea.

Mr. R. Stephenson said, that the system of "catch-water" drains would not be generally applicable in Holland, on account of the flatness of the country, there being little high land, except near Utrecht.

Sir John Rennie thought the Dutch, with all their talent and patient industry, had been somewhat too strongly attached to their old plans. In his opinion, if they had done more by warping on their coasts, they would have succeeded better, and would have saved much expense of embanking.

Mr. Giles thought the "catch-water" drains indispensable for all well-laid-out plans of drainage. It was also essential to establish the outfall at the lowest practicable point, and to place the cill of the sluice at about 2 feet below the low-water mark of ordinary spring tides. This was much wanted in the drainage of the south and middle and Bedford Level, wherein, if the outlets were carried to below Lynn, the depth of the drainage would be increased nearly 6 feet, and little or no pumping, even for the lowest fens, would be required, throughout the district.

Mr. J. SMITH (*Deanston*) did not consider the drainage of the middle Bedford Level sufficient for cultivation; the water should be drawn to at least 4 feet beneath the surface. He admired the principles insisted upon in the paper; the combined effects of a straight and capacious main river, with the "catch-water" drains, must be advantageous. It would be practicable, also, to make use of the power of the high-land water collected in the "catch-water" drains, for working water-wheels, either for draining the lower fens, if any existed, where natural drainage was impracticable, or for other useful purposes, either of agriculture or manufactures. He thought, that the cill of the outlet sluice should be placed more than 2 feet below the low-water mark, as the greater the cubic content of the outlet drain, the greater would be the quantity of water discharged, in a given time, and the greater would be the freedom of the discharge. In the fen districts, the ground ordinarily was so flat, that if the cill was only 2 feet below low-water mark, it would be difficult to reduce the level of the water to 4 feet below the surface, which he must contend for, on behalf of the agriculturist.

Sir JOHN RENNIE explained, that at Ferraby sluice, the tide in the Humber rose between 26 feet and 28 feet, and he had found, practically, that the cill was placed so low, that the farmers in the lowest and the most distant parts of the fen, were quite satisfied with the extent of the drainage.

Mr. J. SMITH (*Deanston*) said, that possibly the farmers were satisfied, because the present state of the district was so much superior to its former condition; but if the level of the water was reduced still more, they might perhaps be better satisfied.

With respect to the overfall weirs and reservoirs for arresting the sand and mud, there was no doubt of their actual utility, and every district would be improved by their introduction. In the present system of surface drainage, large quantities of the lighter particles of the soil were carried by the water, along the open furrows, into the drains; thus filling them up, and at the same time depriving the fields of their soil. This would, however, be in a great degree prevented, when subsoil drainage was more extensively introduced. The surface of the land would then be so arranged, that the rain would filter through into the drains, and it was now found, that even in very rainy seasons, the water from subsoil drains was but little charged with sand, or earthly particles, and that it could be used for many purposes, for which the drainage water had previously been unfit.

Mr. GILES must contend, that there was no necessity for placing the cill of the outlet sluice lower than 2 feet below low-water mark. It was not possible to drain to below that point by natural means; and no extra amount of discharge would be obtained by going deeper. But, on the other hand, there would be a considerable deposit of silt against a cill placed deeper than 2 feet, and the gates would be prevented from shutting accurately.

Mr. J. WALKER said, although it was true that natural drainage could not be carried below low-water mark, yet in order to drain down to that level, the cill of the outlet sluice should be placed as much lower as was practicable. It should be recollected, that the gates only remained open for a short time, during which period it was desirable to discharge as much water as possible; then as the quantity passing through the gates, could be appreciated by multiplying the depth of 2 feet down to the cill, into the width of the opening, and by the time the gates remained open, it was evident that if the cill was fixed at 6 feet or 8 feet below low-water mark, the greater depth, multiplied into the same width, would give a greater sectional area, for the passage of the water, in the same time. The friction of the water would also be less when flowing in a mass of good depth, than when it ran in a comparatively thin stream over the cill.

There was one point in Sir John Rennie's excellent paper, which Mr. Walker would particularly notice. He could not admit, as a general principle, the propriety of giving to the bottom of the main drains, an inclination of 4 inches per mile from the outlet upward; as in a considerable distance, the depth of the main drains would be so diminished as to materially injure the lateral drainage. He was an advocate for the bottom of the drain being quite level, and at the extreme end, from the outlet, in proportion as the extent of the lateral drains decreased, the width of the main drain might be diminished, but the depth should remain the same throughout its length. The efficiency of the drainage did not depend upon any velocity given to the water by the rise of the bottom, which was virtually so inconsiderable, that the water was sluggish or even almost stagnant. It was, however, much affected by the body of water which was pounded up, at an uniform depth, in the whole length of the main drain, and which acquired a velocity, due to its own gravity, immediately the outlet-gates were opened, and in travelling along, it carried away any silt which might have been deposited in the drain, or at the cill: for it must be remem-

bered, that the operation was repeated every tide, thus leaving only a short time for the deposition of silt. His experience, therefore, led him to believe, that the outlet-cill should be laid at 6 feet or 8 feet, below the level of the low-water mark, of the lowest spring tides, in order to produce the utmost effect.

The overfall weirs and reservoirs, were, he thought, good precautions, as they materially decreased the necessity for frequently cleansing the drains.

With respect to the question of the separation of navigation from drainage, to whoever the credit of the introduction belonged, there could not be any doubt of the correctness of the principle. He had insisted upon that system, in the drainage of the Middle Level, and it would be there carried into effect to a greater extent than, he believed, in any other district, and he would have an account of the works prepared for the institution.

In that district, in a distance of 30 miles, there was only a rise of 18 inches, so that a level main drain was indispensable.

It was somewhat extraordinary, that there was so little known of the history of the embankment of the river Thames, which, whether examined with respect to its extent or efficiency, was equally remarkable. It was generally attributed to the Romans, and there was every reason to believe, that it was owing to the sound principles upon which the works had been commenced, that they had been enabled to be continued and kept up since in their present state.* It would be observed, that the land on both sides of the river, beyond the bank, was 7 feet beneath the level of ordinary spring tides, and 10 feet below that of the extra spring tides. The action of the tide had caused the formation of a fore-shore against the banks, which materially assisted them. In short, the embankment of the Thames was, perhaps, the most useful work the Romans had executed in this country, and if they exhibited such a practical knowledge of hydraulic works in one instance, it might be presumed, that they had constructed the Carr dyke, with the intention of its serving as a "catchwater" drain, for which its position evidently fitted it.

It was not always practicable to establish such drains, but wherever they could be formed, there could be no doubt of their advantage to a system of drainage.

* Vide Dugdale's History of Embanking and Draining; 2nd edition, by Cole (folio; London, 1772); and Cruden's History of Gravesend, p. 23 (royal 8vo.; London, 1843.) This latter work contains very good information on these interesting labours of the Romans, and on the present mode of keeping them up.

Mr. J. SMITH (*Deanston*), was decidedly of opinion, that if it was desirable to place the cill of the outlet sluice 2 feet below low-water mark, it would be more advantageous to place it as much as 8 feet below. The great point to be attained, was the freedom of discharge, which would be more readily accomplished, by having a considerable column and great cubic section, than by attempting to obtain great velocity. The silting up, would be more completely obviated, by a considerable mass of water, than by the passage of a less stream, at a greater velocity.

The practicability of obtaining a level main drain, must depend, in some degree, on the nature of the district and the height of the surface of the land. There could not be any doubt of the advantage of giving ample depth of water, and it was decidedly preferable to diminish the width, rather than the depth of the upper end of the drain, particularly in very flat districts, where, in an extent of many miles, there was not more than 3 feet, or 4 feet fall, from the upper point to the outlet.

Mr. FAREY said, that the opinion expressed by Mr. Walker accorded, in a remarkable manner, with that of Smeaton, as recorded in some of his unpublished MSS., from which he had extracted the following passages:—

Deeping Fen Drainage.

Letter from Mr. Grundy to Mr. Smeaton, dated, February 28th, 1770.

"I have taken the levels and surveys; it is a tract of near 40,000 acres, and its uppermost extent, from its proper outfall, near 16 miles, and in breadth 6 miles. Preparatory to forming a scheme for the more perfect drainage of Deeping Fens, near Spalding, I am ordered, by the adventurers of Deeping Fens, to confer with our brother Tofield on the subject matter of draining these fens. As we have made separate reports without any communication with each other, it is no wonder there are some differences in opinion, but one point we cannot reconcile, and therefore have agreed to refer the matter to you. Mr. Tofield recommends digging our drains and rivers to a dead level, or horizontal bottom, from the outfall to the lowest lands to be drained. My opinion, as well as practice is, to form them into one inclined plane, parallel with the mean surface of the country through which they are cut, by which method much expense in digging is saved, and, as I conceive, equally eligible."

From Mr. Tofield, dated March 8th, 1770.

"I had a conference with your friend Mr. Grundy at Retford, upon the subject of

the drainage of Deeping Fens, concerning which we had given separate opinions, the principal difference of which consisted in my recommending the mother-drain to be carried up, from the outfall, upon a dead level bottom, at least 2 feet below the low-water mark in the Wash, into which it is to issue its water; this Mr. Grundy can by no means approve of, because the 2 feet of water in the bottom, he says, will be dead water, and consequently useless to the drainage; and further, that the expense will be considerably increased. The increase of expense I readily admit, but still strongly contend for the necessity of depth, on account of the smallness of fall, which, according to Mr. Grundy's Report, is not more than 4 feet in upwards of 18 miles; and I further beg leave to dissent from his opinion of such water in the drain as lies below his outfall, being absolutely dead water; however, in order to avoid contention as much as possible, we mutually agreed to beg your opinion of this matter."

Mr. Smeaton's Answer to Messrs. Grundy and Tofield, March 27th, 1770.

"I think myself much honoured by the reference of my brothers, Grundy and Tofield, in a matter of art. Messrs. Grundy and Tofield both agree that a canal or drain, dug in such manner that its bottom follows the natural slope of the country, and thereby naturally leaks itself towards the lowest point of natural drainage, is dug at less expense than if carried upon a dead level, from the said lowest point; and still less than if the whole canal is dug below the level of the said point; but the question remaining is, as I apprehend it, from both their statements, taken collectively, whether, when so dug, it is not better and more effectual for drainage, especially in some cases.

"The digging of drains, with sloping bottoms, in the manner specified by Mr. Grundy, and for the reasons assigned by him, is undoubtedly the common practice, but where level has been scarce it has been my practice to do them (or propose them to be done) in the manner assigned by Mr. Tofield. A proposition of which sort has occurred, where I have been concerned with Mr. Grundy, and also one with Mr. Tofield. The drains proposed for the country connected with the Foss Dyke,* done by desire of Mr. Ellison, were at least some of them of this kind; but as this scheme was never executed, Mr. Grundy will probably have forgotten this circumstance. The drains for Potterick Carr were also proposed, and in part executed in this way, which Mr. Tofield cannot but remember,* and not only with level bottoms, but proposed to be dug (if my memory does not fail me) 2 feet below the level of the water at the point of delivery.

"A drain may be considered as differing from a pipe only in having but three sides, instead of four, or the not being compassed all round; and that, however deep the drain may be, like a syphon, it runs to the very bottom. Thus, if a canal was dug on a dead level, 10 miles long, and 10 or (if you please) 50 feet deep of water, and if a quantity of water enters one end, and passes off at the other, over a cascade of a quarter of an inch depth of water, yet the whole body will be in motion from one end to the other. Natural currency of water is in consequence of its falling, or moving from a higher place to a lower, the greater the fall (under equal circumstances) the greater will be the velocity; and therefore (*vice versâ*) the lesser the velocity given, or required, the less fall is required to produce it.

"In a pipe, it is only necessary, that the end by which the water is to be discharged, be lower than the end by which it enters; for being inclosed on all sides, it cannot escape but by moving forwards, though the pipe itself should be below the level; but in a drain, which is open at top, the upper surface of the water forms a slope, from the upper end of the drain to the lower, which indeed cannot be otherwise, for if you suppose any part depressed too low, the descent being greater (in proportion) to this part than the rest, the water will flow in, till the whole, with the powers respectively acting upon each part, are in equilibrio. This principle forms the inclination of the upper surface of running waters in open canals, and that more or less inclined, in each particular part, according as the velocity required is greater or less; which required velocity depends upon the section in the place: it holding always true, that an equal quantity must, in the same canal, or pipe, pass in a given time through every section thereof, and consequently, that the velocity will be inversely as the area of the section.

(*To be concluded in our next.*

THE "GREAT BRITAIN'S" THIRD VOYAGE.

The *Great Britain*, which left Liverpool on the 27th ult., on her third transatlantic

* Vide Smeaton's Reports, I. 55 (4to, 1762.)

* Ibid., I. 55 (1764.)

voyage, did not reach New York till the 15th inst. She appears to have had a narrow escape from shipwreck. We extract the following from the *Shipping Report*:—

"Left Liverpool 4 p.m., 27th September; the first 10 days experienced westerly winds, strong gales, and heavy sea at times, during which the ship behaved admirably. For a few hours of the 2nd of October, the wind was N.E., and in a heavy squall the foremast was carried away. On the 12th, at noon, found the ship had been set 36 miles to the northward in the preceding 24 hours; and on that night found by soundings that the ship again set to the northward 30 miles, from noon of the 12th to 2 a.m. of the 13th; and among the shoals of Nantucket a thick dirty night with very heavy rain; at daylight made signal for a pilot and ran into Vineyard Sound, stopped 10 hours and a half at Holmes' Hole, left it at half-past 2 a.m. of the 14th, and reached Sandy Hook at 11 o'clock p.m., and remained outside for want of water."

The following extract of a letter from one of the passengers, with an inspection of which we have been favoured, adds some interesting particulars.

"Holme's Hole, Martha's Vineyard,
Monday, about 8 P.M., Oct. 13, 1845,
On board the *Great Britain*, at anchor.

"Here we are, after a voyage so far, which has been most tedious, and not without danger. Fuel nearly exhausted, though we are still 200 miles from New York. Our foremast is gone; three arms also of the propeller, (as the captain informs us,) and all on one side, which last, however, is scarcely credible, as I have not been able to detect any irregularity in the engines, which such a state of things must, I think, have produced. It appears, by the captain's account, that after Saturday a strong current carried us, in spite of his efforts to steer for Block Island, (across St. George's Banks,) right among the breakers off Nantucket Island; they are called the Rips, and might have proved themselves of the worst kind (of rips) had anything but fine weather accompanied us in our excursion among them. The natives here express their astonishment at our not being wrecked among them, and no doubt the danger has been most imminent. The captain called several of us into his cabin before breakfast this morning, and informed us that he had not coal for more than eighteen hours' steaming; that three arms of the propeller, all on one side, were gone (?), that he was afraid of steaming out to sea, lest any accident should happen to the propeller, and disable him from beating (or clawing) off shore, when a gale might carry him again among the breakers; in which case, of course, there would be great danger of being wrecked. I should tell you that we had long before this fired guns and hoisted signals for a pilot. We had taken a *farmer* pilot on board who advised to go round a point within the breakers, on the east of Nantucket I think it must be; but another pilot came off the island and would not carry us through, but advised passing through the Sound, between Martha's Vineyard and Rhode Island, and here we are taking in coal. We had on board at starting, 10[illegible] tons, so that we have consumed about 6[illegible] tons per 24 hours. Condenser, 26½ in.; boiler, 3½ in.; cut off at 16in. to 13 generally, making about 13½ strokes per minute.

"Now for the log. (for this see next page.) The last voyage was about 3147 miles; it is sometimes less than 3000, but usually 3100. After leaving Halifax, we must have gone wrong, or soon after. I have no [illegible] but you will find that we must have had a narrow escape soon after leaving Nova Scotia. Two inches had been riveted to each arm before leaving Liverpool, making the disc of the propeller 4 inches more. [illegible] was a clumsy job, and was, no doubt, the cause of the breakage."

Log of the "Great Britain."

DATE.	N. LAT.		W. LONG.		MILES.	REMARKS.
Saturday, Sept. 27, 3½ P.M.	°	′	°	′		Engine started. Passed Prince's Dock, 4 P.M.
Tuesday, Sept. 31, Noon	51	25	14	0	472	Fine weather; but wind a-head.
Wednesday, Oct. 1, ,,	51	30	17	42	139	Ditto; passed Great Western; bad weather.
Thursday, ,, 2, ,,	51	15	22	36	185	Ditto.
Friday, ,, 3, ,,	50	22	27	57	213	Fine; rough gale; sail abaft the funnel came down by the run, also foremast with spanker set, went by the board in a white squall, and another sail abaft the first one came down. Some hours were occupied in fishing up the sails and spars out of the water; but the engines were only stopped about half an hour.
Saturday, ,, 4, ,,	49	57	32	26	175	Wind a-head.
Sunday, ,, 5, ,,	49	40	35	50	135	Ditto.
Monday, ,, 6, ,,	49	11	39	36	150	Fine; stormy.
Tuesday, ,, 7, ,,	48	33	42	24	120	Fine, but rough.
Wednesday, ,, 8, ,,	47	53	47	20	202	Passed Britannia; saw icebergs.
Thursday, ,, 9, ,,	46	38	53	00	241	About 1½ mile from Newfoundland.
Friday, ,, 10, ,,	45	27	58	17	231	Fine.
Saturday, ,, 11, ,,	44	8	62	55	220	Opposite Halifax; broke propeller & stopped to examine.
Sunday, ,, 12, ,,	43	36	67	32	222	Fine.
Monday, ,, 13, ,,	..		..		2705	

LIST OF ENGLISH PATENTS GRANTED BETWEEN SEPTEMBER 25 AND OCTOBER 10, 1845.

(Concluded from page 288.)

Frederick Harlow, of Paradise-street, Rotherhithe, carpenter, for certain improvements in atmospheric railways. October 10; six months.

Charles Nossiter, of Lyndon End, near Birmingham, for improvements in the manufacture of leather. October 10; six months.

James Hardcastle, of Firwood, Bolton-le-moors, Lancaster, esquire, for certain improvements in the method of conveying water. October 10; six months.

Charles Hansom, of Huddersfield, watch-maker, for certain improvements in clocks, watches, or time-keepers. October 10; six months.

James Knowles, junior, of Bolton-le-moors, coal-merchant, and Alonzo Buonaparte Woodcock, of Manchester, engineer, for certain improvements in machinery or apparatus to be employed for raising coal or other matters from mines, which improvements are also applicable to raising or lowering men or animals, or other similar purposes. October 10; six months.

William Hodson Greatrix, of Nuneaton, Warwickshire, ribbon weaver, for certain improvements in looms for weaving ribbons and other fabrics. October 10; six months.

James Taylor, of Lochwinnoch, Renfrew, carpet and rug manufacturer, for certain improvements in the manufacture of carpets, rugs and piled fabrics. October 10; six months.

Edmund Barber, of Tring, Herts, decorative painter, for certain improvements in graining and decorating in oil, distemper, and other colours, and in imitating marbles, granites, fancy and other woods, and in the apparatus and instruments to be used therein. October 11; six months.

Benjamin West, of Saint James's-walk, Clerkenwell, book-binder, for certain improvements in covering or stoppering the tops of bottles, jars, pots, and other similar vessels. October 16; six months.

Stephen Reed, of the town and county of Newcastle-upon-Tyne, gent., for certain improvements in railway rails and chairs. October 16; six months.

William Elliott, of Birmingham, button manufacturer, for improvements in the manufacture of buttons. October 16; six months.

John Barsham, of Long Melford, Suffolk, manufacturer of bitumen, for improvements in the manufacture of mattresses, cushions, brushes and brooms, and in machinery for preparing certain materials applicable to such purposes. October 16; six months.

John Marshall, of Southampton-street, Strand, tea dealer, for improvements in preparing cocoa and chocolate. October 16; six months.

William Betts, of Smithfield-bars, distiller, for improvements in the manufacture of brandy, gin, and rum, and other British spirits and compounds. October 16; six months.

James Webster Hall, of Fitzroy-square, gent., for improvements in machinery for cleaning or freeing wool and certain other fibrous materials of burrs and other extraneous substances. October 16; six months.

Hippolite Pierre Francois Desgranges, 1, Skinner's-place, Size-lane, gent., for an improvement or improvements in the mode of manufacturing

corks. (Being a communication.) October 17; six months.

William Henry Stephenson, of Nottingham, merchant, for certain improvements in machinery or apparatus to be used in dyeing or staining. October 17; six months.

Joseph Orsi, of Pimlico, gent., for improvements in sleepers, or blocks for supporting railways. October 23; six months.

Thomas Taylor, of Manchester, cabinet maker, for certain improvements applicable to machinery or apparatus employed for sawing timber. October 23; six months.

Thomas Worsdell, jun., of Stratford, Essex, railway-carriage builder, for certain improvements in apparatus to be attached to and employed in connexion with railway carriages. October 23; six months.

Arthur Smith, of Saint Helen's, manufacturing chemist, for certain improvements in the manufacture of soda ash. October 23; six months.

William Coles Fuller, of Brownlow-street, Holborn, cabinet maker, for improvements in the construction of carriages for railways. October 23; six months.

William Thomas, London, merchant, for certain improvements in the construction of umbrellas and parasols. October 24; six months.

LIST OF PATENTS GRANTED FOR SCOTLAND, FROM THE 22ND OF SEPTEMBER TO THE 22ND OF OCTOBER, 1845.

Charles Murland, of Castlewellan, in the county of Down, and kingdom of Ireland, flax-spinner, and Edward Lawson, of Leeds, in the county of York, machine maker, for certain improvements in machinery for preparing and spinning flax, and other fibrous substances. Sealed, September 23.

John Kershaw, of Ramsbottom, Lancaster, cotton spinner, for certain improvements in machinery or apparatus used in the preparation of cotton or other fibrous substances for spinning. September 24.

Joseph Francois Larbereau, of Paris, in the kingdom of France, gentleman, for improvements in obtaining power. September 24.

Charles Pooley, of Chorlton-upon-Medlock, Lancaster, cotton spinner, for improvements in certain machines used in preparing to be spun, and in spinning cotton, wool, and other fibrous substances. September 24.

Moses Poole, London, gentleman, for improvements in rails for railways. (Being a communication from abroad.) September 24.

Bennet Woodcroft, of Manchester, engineer, for improvement in propelling vessels. September 24.

William Cormack, of Dalglish-street, Commercial-road, Middlesex, chemist, for improvements in purifying gas. September 24.

James Taylor, of Lochwinnoch, Renfrew, carpet and rug manufacturer, for certain improvements in the manufacture of rugs, carpets, and other piled fabrics. September 25.

James Murray, residing at Garnkirk, Scotland, partner of and acting for his co-partners of the Garnkirk Coal Company, for certain improvements in the manufacture of bricks, tiles, pipes, or other articles made of ground or pulverised fire clay, or other clay, by pressure. October 1.

Samuel Knight, of Spotland, near Rochdale, Lancaster, bleacher, for certain improvements in machinery or apparatus for scouring, washing, cleansing and other similar purposes. October 2.

William Broughton, of New Basinghall-street, London, millwright, for improvements in machinery or apparatus for grinding grain, drugs, colours, or other substances. October 2.

Dominic Frick Albert, of Manchester, Lancaster, consulting manufacturing chemist, Doctor of Laws, for a certain improved application of materials to the manufacture of soap. October 2.

William Henry Ritchie, of Lincoln's-inn, Middlesex, gentleman, for improvements in carding engines. (Being a communication from abroad.) October 2.

James Knowles, junior, of Bolton-le-Moors, Lancaster, coal merchant, and Alonzo Buonaparte Woodcock, of Manchester, engineer, for certain improvements in machinery or apparatus to be employed for raising coal or other matters, from mines, which improvements are also applicable to raising or lowering men or animals, or other similar purposes. October 6.

John Mercer, of Oakenshaw, Lancaster, calico-printer, and John Barnes, and John Greenwood, of Church, in the same county, manufacturing chemists, for certain improvements in the manufacture of certain chemical agents used in dyeing and printing cottons, woollens, and other fabrics. October 7.

William Henry Fox Talbot, of Lacock Abbey, Chippenham, Wilts, Esq., for improvements in obtaining motive power, and in the application of motive power to railways. October 7.

William Lykes Ward, of Leathley Lodge, Hunslet-lane, Leeds, gentleman, for improvements in exhausting air from tubes or vessels for the purpose of working atmospheric railways and other purposes, and improvements in the valves and tubes of atmospheric railways. October 7.

Dalrymple Crawford, of Stratford-on-Avon, Warwick, gentleman, for an improved dibbling machine. October 7.

Paul Ackerman, doctor of medicine, of No. 1, Skinner's-place, Size-lane, London, for certain improvements in harpoons, and other similar instruments. October 9.

Giacomo Silvestri, doctor of medicine, of No. 87, Piccadilly, for certain improvements for the conservation of animal or vegetable organic matter. October 9.

Stephen Hutchinson, of the London Gas Works, Vauxhall, Surrey, engineer, for certain improvements in gas meters. October 9.

Richard Archibald Brooman, of the Patent-office, 166, Fleet-street, London, gentleman, for a thread made from a substance not hitherto applied to that purpose, and also the application of it to the manufacture of piece goods, ribands, paper, and other articles. (Being a communication from abroad.) October 10.

William Henry Stevenson, of Nottingham, merchant, for certain improvements in machinery or apparatus to be used in dyeing or staining. (Being a communication from abroad.) October 14.

Henry Grissell, and James Lewis Lane, of the Regent's Canal, engineers, for certain improvements in weighing machines, and also in steelyards. October 14.

Frederick Rosenborg, Kingston-upon-Hull, gent., and John Malam, also of the same place, gentleman, for certain improvements in apparatus for watering, manuring, and drying trees, plants, seeds and roots, and for accelerating, and improving the growth and produce of trees, plants, seeds, and roots. October 16.

NOTES AND NOTICES.

Minuteness of Matter.—Air can be rarefied so far that the contents of a cubic foot shall not weigh the tenth part of a grain; if a quantity that would fill a space of the hundredth part of an inch in diameter be separated from the rest, the air can still be found there, and we may reasonably conceive that there are several particles present, though the weight is less than the *seventeen hundredth million of a grain.*

The Tides.—The only place on the earth where the solar tide is greater than the lunar tide, is at Courtown Harbour, south of Dublin. In all other places the lunar influence predominates to the extent of about 4½ times (according to Newton).

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

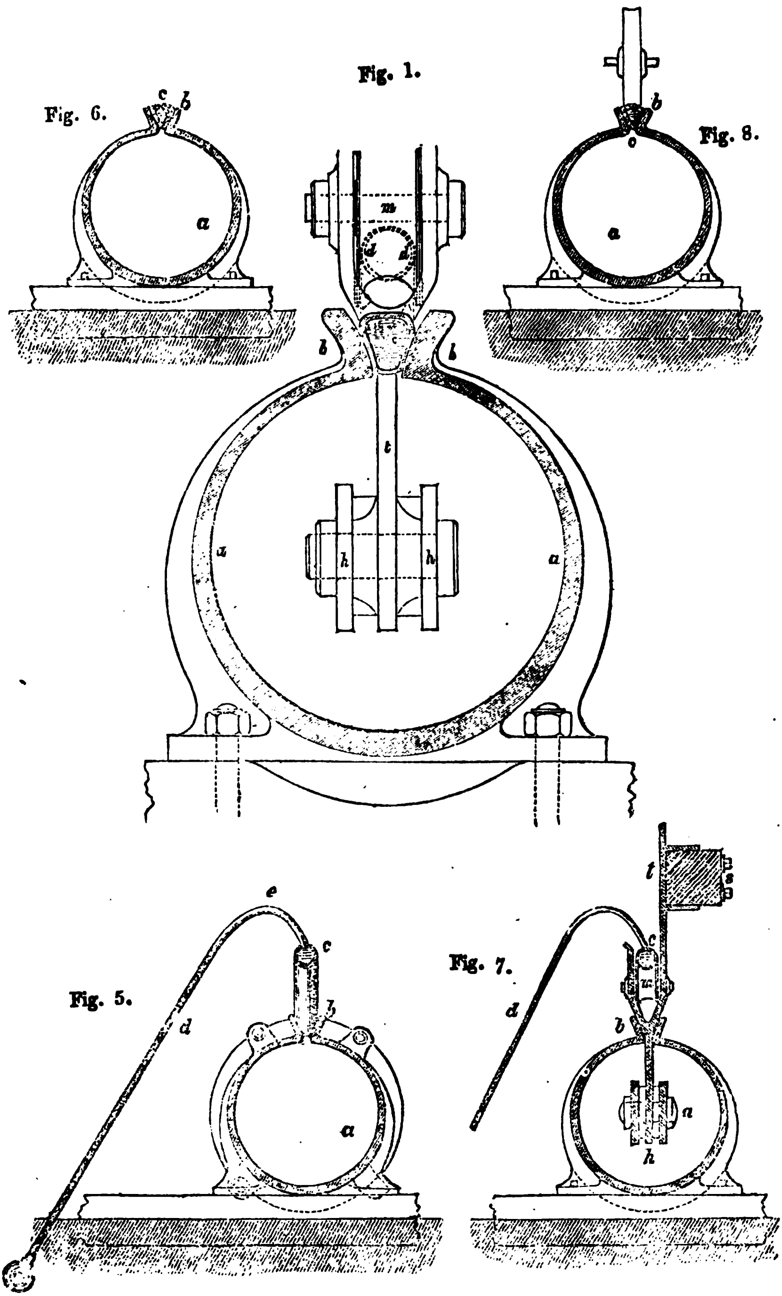
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1161.] SATURDAY, NOVEMBER 8, 1845. [Price 3*d.*

Edited by J. C. Robertson, No. 166, Fleet-street.

MR. R. MALETT'S NEW LONG VALVE AND MAIN FOR ATMOSPHERIC RAILWAYS.



MR. R. MALLETT'S NEW LONG VALVE AND MAIN FOR ATMOSPHERIC RAILWAYS.—(SEE CURRENT VOLUME, MECH. MAG. P. 232.)

The objects in view are to diminish the cost of the main and valve, simplify their parts, and diminish leakage which occurs to so great an extent with Clegg's valve. The main is cast with a pair of jaws, one on either side of the long slot, through which the coulter travels. These jaws are formed to a particular curve, (see fig. 1,) and are cast against "a chill" by which they are obtained perfectly smooth, fair, straight and hard, and thus the cost of "planing" the valve faces is avoided. The valve consists of a continuous-hollow tube or hose, of woven hemp, coated throughout with caoutchouc, like the tube of a stomach pump, or other such instrument. This tube is maintained full of water or brine in cold climates, and when it is closed as a valve, is forced in between the jaws of the main, and acts like a sort of continuous cork. As the coulter, &c., travels along, the tube is lifted up a few inches out from the jaws, by suitably formed rollers, and as soon as the coulter has passed, it is pressed back again into the cavity between the jaws by a roller pressing upon its upper surface.

In place of a hollow hose full of fluid under a constant small head, or of compressed air, a compound continuous cork formed of four cotton ropes embedded in caoutchouc. This is, in fact, one of Brockedon's patent stoppers of indefinite length. Either arrangement would admit of sufficient extensibility in length to allow the lifting up and pressing down of the valve at the passage of the coulter without injury.

The outer surface of the valve, in either case, should be coated with an unguent, which will not act on the caoutchouc; if vulcanized India rubber be used, common palm oil will answer. Pinkus's valve was a continuous flat band of leather, and failed, because when close, it had no tendency to keep in its seat, and its edges were *thrown up* by the pressure of the atmosphere on its centre part.

Hallette's valve consists of *two* continuous tubes full of compressed air, by the elasticity of which they are forced against each other, and the main thus attempted to be made staunch; but the serious defect appears to be, that the tendency of the atmospheric pressure upon the outside of these artificial lips is to force them asunder, so that the exhaustion of the tube tends to produce, in place of to diminish, the leakage of the valve. The present contrivance, which has something in common with both Pinkus's and Hallette's arrangements, through invented long before the latter published his plan, appears free from the disadvantages of either, and to possess several advantages not offered by any other valve proposed.

The letters refer in common to all the figures. Fig. 1 is a transverse section of the improved main and valve. *a a* is the main; *b b*, the valve seat, the opposite faces chilled; *c*, the tubular valve in its seat; when raised at the passage of the coulter it assumes its cylindrical form, as shown in dotted lines, *d d d d*, passing over the sheaves, or rollers *m*, &c.; *t* is the coulter seen endwise; *h*, the rib of the travelling piston.

Fig. 2 is a plan and section horizontally of the atmospheric main, *a a*; *b b*, the valve seat or jaws, cast with "chilled" faces—(these are best seen in section, fig. 1.) The lengths of main are put together with abutting rabbeted flange, or rather lugged joints, at every 15 feet, with a flange of India rubber $\frac{3}{16}$ inch thick between, the elasticity of which allows for expansion of the main, and yet keeps the joint air-tight.

Fig. 3 is a horizontal section of the tube, and plan of the piston.

Fig. 4 is a vertical section of the tube, and elevation of the piston.

Fig. 4a is an elevation of the entrance of the tube.

Fig. 5, transverse section of the valve as raised; fig. 6, a transverse section of it as closed; fig. 7, a transverse section on the line A B of fig. 4; and fig. 8, a transverse section on the line C D of fig. 4.

From the facility given for support of "the cone," by the "chill," for casting, the valve seat faces on the main, as thus designed, can be as readily cast in 15 feet lengths as in 9 feet, which has been the limit of Samuda's practice. *c* is the tubular valve of woven hose, covered with caoutchouc, or of caoutchouc and cotton solid: it is here shown hollow, and is maintained full of water by a small flexible tube *d*, at either end of the section of main joined to the extremity of the

Fig. 2.

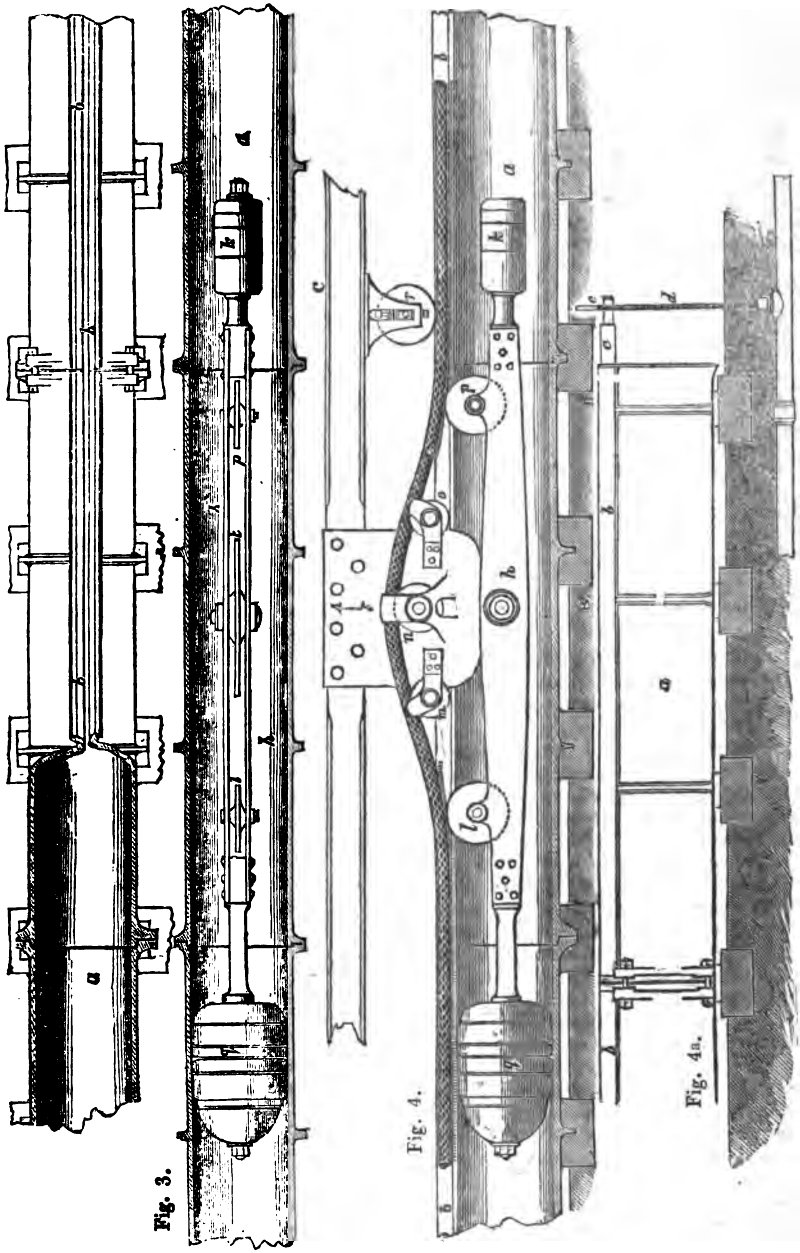


Fig. 3. Fig. 4. Fig. 4a.

brass nosle and bend *e*. This little tube connects also with a small water-main *f*, laid under the ballast of the road, and in connexion with a head of from 5 to 10

feet of water, by which the tubular valve is always kept full and "plump." This little supply tube is so placed as to be passed by the coulter, &c., and to permit the valve to be lifted up and pressed back again into its seat. *g* is the travelling piston-head; *h*, the rib or frame of the travelling gear; *k*, the balance-weight; *l*, *m*, *n*, *o*, the hollow grooved rollers, made like ordinary "sheaves," which gradually *lift* the tubular valve out of its jaw-shaped seat, to permit the coulter to pass with the piston; the first and last of these, *l* and *o*, are narrow enough to pass up between the jaws, or into the longitudinal slot, and are of hardened steel; *r* is the roller, with a slightly concave edge or rim, which, attached to the porch of the leading carriage *s*, presses down the tubular valve into its seat, something like forcing a continuous cork into the neck of a bottle, and so leaves the main ready for fresh exhaustion after the passage of a train; *t* is the coulter of plate iron five-eighths of an inch thick, carries the rollers, piston, &c., and attached to the perch *s*.

THE "GREAT BRITAIN'S" LAST VOYAGE—THE PERFORMANCES OF HER ENGINES COMPARED WITH THOSE OF THE "GREAT WESTERN."

Sir,—I have read your account of the third voyage of the *Great Britain* in last week's magazine, and am both surprised and annoyed at the results there detailed. I learn from the account referred to that the consumption of fuel is 63½ tons per day, which, if employed as it ought to be, should give out fully 900 horses power without any extraordinary degree of expansion; but we are told the steam was generally cut off at 13 inches of the stroke, so that it must have expanded between five and six times; hence the power realized should have been very much above 900 horses. Mr. Guppy (the Director of the company, under whose superintendence these engines were made) stated, at the Institution of Civil Engineers, that the steam was generally cut off at one-sixth of the stroke, (of 6 feet;) hence the statement, here referred to, of its being cut off at 13 inches, is no doubt correct. Now, to me, the unaccountable part of the affair is this: The boilers of the *Great Western* supplied sufficient steam at 8½ lbs. for 15 strokes, without working the expansion gear; and I know from indicator cards I have seen, that when so working, the cylinders of 72 inches diameter were filled six feet out of the seven with steam of 3 lbs. above the atmosphere. Now, at 15 strokes, the two engines of the *Great Western* would consume 10,177 cubic feet of steam per minute. The heating surface of the boilers of the *Great Britain* is about 8,500 feet, that of the *Great Western* was about 4,000 feet. The quantity of coal consumed in the latter was about 24 cwt. per hour, the former 53 cwt. in the same time; hence it follows that the quantity of steam generated in the *Great Britain* should be more than double that of the *Great Western*.

But if we take the diameter of each of the four cylinders of the *Great Britain* at 88 inches and the revolutions at 14, we find that the quantity of steam that should pass through the engines in one minute (cutting it off at 13 inches of the stroke) is 5,096 cubic feet. Now, I should like to know what goes with the rest; for that a much greater quantity is generated I have no doubt, although not sufficient to produce the most satisfactory results, because the surface in the boilers should have been at least 12,000 feet.

I should advise Captain Hoskins to have his engines carefully examined by a *practical* mechanical engineer of known standing, conversant with the application of steam to marine engines. He will have found by this time that it is perfectly useless for Directors to become their own engineers, or the constructors of railways to attempt marine engine building.

I am, Sir, your obedient servant,

G. S.

London, Nov. 3, 1845.

COMMANDER HOSEASON'S LETTERS ON WORKING STEAM EXPANSIVELY IN THE ROYAL NAVY.

Sir,—I have just read your reprint of Mr. Hoseason's letters to Sir W. Parker, &c., with Binnacle's eulogium, and your commendation thereon.

Although I admire talent in any grade, and have always looked favourably on the efforts of the Otways, Hoseasons, and others, for the benefit and enlightenment of their benighted navy brethren in the

science of the steam engine, still it is going rather too far to allow them to appropriate to themselves as their individual inventions, the most common laws and fundamental rules of civil engineering, as applied to marine purposes.

The work published by Lieut. Otway is so full of glaring errors in almost every page that it would be necessary for the naval student to unlearn almost every thing he had there imbibed, before he could enter on a sound course of instruction.

Let us now advert to the letter of Lieutenant (now Commander) Hoseason to Sir W. Parker, republished in No. 1158. We there find him accounting for, and explaining the statement of Captain Oliver, "that in the *Phœnix* he could, full consumption, steam only 9 knots, and half consumption, 7 knots," in this sort of a way, that "the resistance of fluids is as the squares of the velocities," *consequently* $7^2 = 49$ and $9^2 = 81$, or *nearly* double! Surely, comment is unnecessary on so absurd a figment as this.

If he had told his brethren, that "the required horse power is as the cubes of the velocities," he would merely have disseminated a fact that has been known to marine engineers for many years past, almost before steam was used in the navy, and subsequent practice has so proved this rule that no doubt exists of its truth. We elucidate it by the statement of Capt. Oliver.

The *Phœnix* (at the time referred to) was fitted with Maudslay's engines. Cylinders 55 inches diameter, and 5 feet stroke; therefore collective power =110 horses. The maximum velocity is stated to have been =9 knots, and with *half consumption* =7 knots.

The cube root of 100 is=4·79*

The cube root of 55 is=3·80

Then, as 4·79 : 9 knots : : 3·80 to 7·18 knots, or just the asserted speed at *half* the consumption of coals, simply because *half* the *power* was exerted, or only 55 *horses;* but all this had nothing to do with the question of the expansion of *high* steam in its true sense, because the *Phœnix* had then no expansion valve, and the object was obtained by the "throttling of the valve."

Mr. Hoseason writes as if the theory of expansion was a new thing; in fact, that he had almost discovered its practical application: this is a fallacy that he will do well to forget; it was known to engineers and is to be found laid down by competent authors many years before his time; nay, it had been *practically used* in private steamers.

If his friends claim for him the mere reiteration of known principles, upon the dull comprehensions of Lords of the Admiralty, he has undoubted merit—although in this Otway certainly took the lead. I mean when he was in command of the *Echo*, fitted with Cornish boilers, working under a pressure of 15 lbs., and expanding about two-thirds of the stroke. (See his book published by Sherwood, 1834.)

Within the last three years, it was a rule of the Government engineers "that no boiler should work under a greater pressure than 5 lbs. per square inch." What then are engineers to do with such absurd regulations as this pressing upon their exertions? It is well known that in private vessels a much higher pressure is used with a great degree of expansion, and of course, corresponding economy in the consumption of fuel.

These remarks are not written with any ill feeling towards Lieut. H., but I think he claims far too much.

I am your obedient servant,

PRESSURE NOT PUFF.

* I have put it thus that it may be understood by all parties.

THE PRINCIPLES AND PRACTICE OF DRAINAGE.

[Concluded from page 331.]

"From the above premises it follows, that where a given quantity is to pass off, the greater the section is, in which it passes, the less inclination or difference of level will suffice, or on a given difference of level, the greater the section the more will pass.

"The section may be increased by widening, but if it runs shallow, suppose 1 foot deep, on 20 feet wide, if the width is increased to double, it will undoubtedly, on the same inclination, run a double quantity, viz., it will act as two drains of 20 feet (or nearly so): but if you dig the 20-foot canal 1 foot deeper, so that the area of the section of its water may also be 40 square feet; in the latter case the whole body of water will be contained in a circumference of 24 feet, whereas in the former it will be surrounded by 42 feet; and as a great deal of impediment

and resistance to the water's motion, arises from its action against the containing sides, it follows, that a greater velocity, upon the same inclination, will be generated in the latter section than the former; that is, it will run more water through the same section, or the same quantity of water being determined, since a lesser inclination will suffice to generate the same velocity, the canal will empty itself at the upper end to a lower level, and thereby better drain the land.

"To resume my former illustration, of a canal 10 miles long, and 10 feet deep of water, being supplied at one end, with as much water as will form a cascade at the other end, running a quarter of an inch deep; the width is not material, if we suppose the cascade to be of equal width with the canal; though, for the sake of fixing our ideas, we will suppose the width 60 feet, I say, that (without applying to calculation) I should not expect the rise of the canal at the entering end, in order to discharge such a quantity, to be above 2 inches higher than the cascade end, whereas, was you to conduct the same quantity of water for 10 miles, upon a bottom inclined from the solid top of the cascade, so as to run nowhere deeper than a quarter of an inch, I do not suppose an inclination of 100 feet would bring it, though you was to bring it on boards planed and jointed as smooth as art could make them.

"I therefore consider a canal having 4 feet natural descent in 16 miles, dug upon a dead level bottom, as equivalent to a canal dug, in the whole, 2 feet deeper than if the bottom is made to rise 4 feet in that length; and with less expense of leakage; because a canal dug with a sloping bottom, in the whole 2 feet deeper, must for one-half of it be dug under level of the natural discharge; and the level bottom will have this further advantage in dry times, when the quantity entering becomes very little, that the surface of the canal at the upper end will fall nearly to the level of the lower, whereas in the inclined bottom it can never run below the bottom; this circumstance may sometimes indeed be a disadvantage, by reducing the water in the drains, in the interior part of the drainage, too low; but where descent is scarce, and consequently the drainage is liable to be languidly, or imperfectly performed, it will be a very great help, in getting the drainage of the same more early completed; and after all there are always means of restraining it."

Letter from Mr. Grundy to Mr. Smeaton, July 31st, 1770.

"I cannot but be satisfied with the reasoning contained in your solution of that question, as being metaphysically true; yet I cannot say I am convinced, that the highest advantages obtainable in point of velocity, by digging a drain to a dead level, can by any means compensate for the additional expense which must attend such practice, especially where the fall is anything considerable; and was that to become a fixed principle, it might be construed to extend and operate in some cases, so as to introduce 10 or 20 feet unnecessary depth to be dug; and as it but rarely happens that the falls we find in countries to be drained are by nature made sufficient to convey their waters to sea, by proper drains made on a parallel to the inclination of the plane of the surface, I yet think it more eligible to pursue that practice; and more particularly so, because in the other instances, where the fall is found inadequate for a natural drainage, engines must be introduced to perform it artificially. I do not recollect that we proposed making our drains on a dead level in our schemes for the drainage of the country connected with the Foss Dyke."*

Mr. Giles contended, in spite of what had been stated, that a depth of two feet below low-water mark at sea was sufficient for drainage, as all marshes were situated at a level between high and low-water marks.

Sir John Rennie said he could not have any hesitation in admitting the correctness of the principle of level bottoms, for main drains, in very flat districts; but almost every case of drainage had peculiar features, and in the Ancholme, it must be remembered, that in a distance of about 14 miles there was a fall of nearly 20 feet; while in the catch-water drains, into which the high-land waters descended with a certain velocity, there was a far greater fall; therefore the rising bottom was not only not injurious but was highly advantageous in that instance; because it enabled the floods to be carried away with sufficient rapidity, without incurring the extra expense of cutting the drain so much deeper. The case of the middle level was totally different there, as Mr. Walker very properly stated, the fall being only about 18 inches in 30 miles, there was no alternative but to make the bottom of the drain level, and to give great sectional area, because those drains must act as reservoirs to receive the great mass of water which inevitably fell into them, and which could only be discharged during the short time the sea sluices were open at each tide; but even presuming that the cill of the outfall sluice be laid from 6 feet to 8 feet below low-water mark in the Ouse; still when the

* *Vide* Smeaton's Reports, vol. i. p. 82 (4to. 1762.)

river Ouse should be improved below Lynn, as was contemplated, the low-water mark in front of the sluice, proposed by Mr. Walker, would be lowered 5 feet or 6 feet, so that the cill of the sluice would then be only about 2 feet below low-water mark, as Mr. Giles had stated.

Sir George Cayley observed, that he had been for more than thirty years one of the directors, for carrying out the provisions of the Muston Drainage Act, including about 10,000 acres of land near Scarborough. This drainage was effected under the direction of the late Mr. William Chapman, of Newcastle-upon-Tyne, who had great experience in such matters. The drains appeared to combine in their just and most economical proportions, the two adverse principles at issue in the previously expressed opinions. In that extensive and gently rising marsh, the dead level principle was adopted from the lowest outfall, till the surface of the water in the drain, at ordinary times, was within about 4 feet of that of the soil, which level was found sufficient for the purpose of draining the adjacent lands. From this point, the drains took the average rise of the marsh, and continued it for several miles; thus furnishing, at the cheapest possible rate, a very useful and efficient drainage, to all the lands under the Act. Had the dead level been continued throughout the whole length, the expense would have been enormous, without rendering the drainage more complete, and had the dead level not been brought up to the point named, many hundred acres of the lower portion of the swamp would not have received any benefit.

The general plan of the Muston Drainage might be thus stated. The small rivers Hartford and Derwent, with several brooks, held their courses through an extensive marsh, and in times of heavy rain they overflowed their banks and flooded the land to a great extent. No expense whatever was incurred for cutting channels, deep enough to convey away the flood waters of these rivers, or brooks, but they were allowed to keep their ancient levels, and embankments were made near them, on each side, by cutting deep back drains, for carrying the dead water from the lands, and casting up the soil excavated from them, on to the sides next the rivers or brooks. By this process, all the great body of water was conveyed, in times of flood, within these embankments to the lowest outfall; and the deep cutting, which he considered the *sine qua non* of an efficient drainage, and the expensive part of it, was entirely confined to such moderate-sized drains as were sufficient merely to convey the dead water from the land. Another practical advantage, of the deep back drains being contiguous to the embankments, was, that when they received any injury from cracking, after long droughts, or the burrowing of moles and water rats, and thus permitted the flood-water to pass in some degree through them, the back drains interrupted it, and preserved the land from injury.

The original cost of this drainage was about 40,000*l.*; and the annual repairs averaged about 800*l.* The improved rent was obtained at about four or five years' purchase.

The expense of this drainage had been much increased by local circumstances, and which could scarcely be supposed to occur in any other cases, and therefore it was unnecessary to detail them; but these circumstances took place at a distance from the marsh land, and in no way invalidated the state of the case.

Sir John Rennie said, that Mr. Telford, in his drainage works, had as nearly as possible acted upon an uniform system, similar to that which had been described; but that, in particular cases, it was necessary to adopt peculiar methods. It was certain, however, that in all cases it was essential to commence the drainage at the lowest point of outfall, and to work inwards, towards the head of the marsh. In the Bedford Level that system had been neglected, and to that circumstance Sir John Rennie attributed much of the difficulty that had been experienced.

It was always a point of importance to restore the rivers to their natural state, of main drains for the country. At Boston, in the year 1826, he recollected seeing the bed of the river nearly dry, at the time of wha ought to have been high water. Since then the outfall below Boston had been improved, by making a cut across Burton's Marsh and improving the channel of the river upwards, upon a plan proposed by him; the effect of these works had been such, that vessels, drawing upwards of 14 feet of water, now arrived at Boston.

THE MIXTURES MOST SUITABLE FOR OBTAINING BY ELECTRIC PRECIPITATION COPPERPLATES OF SUPERIOR FINENESS. BY PROFESSOR VON KOBELL.

[From Translation in Silliman's Journal.]

"In order to attain a uniformity in the current, I tried what would be the effect of adding to the solution of the sulphate of copper other salts, which resist the action of such feeble currents as are here called into

play, and I thus obtained a copper of the most admirable quality. The salts I thus employed were Glauber's salt, sulphate of zink, potash, alum, and saltpetre. Chlorides are not available; for they become decomposed and thus act on the silver on which the pictures are painted. These salts, or rather the saturated aqueous solutions, with the exception of the sulphate of zink, take up as much sulphate of copper as common water does. I have determined the amount of the oxide of copper contained in an ascertained quantity of these solutions, and have ascertained therefore, by calculation, what is the quantity of sulphate of copper which they take up. I find that 100 parts by weight of spring water dissolve about 27 parts of sulphate of copper; 100 parts of a solution of Glauber's salt 27·5; 100 parts of a solution of potash alum, 27·4; 100 parts of nitrate of potash, 25·4; but 100 parts of sulphate of zink, only 7 parts of sulphate of copper.

"As a precipitation fluid, there are two mixtures which I usually employ,—the first consisting of two parts, by measure, of a saturated aqueous solution of sulphate of copper, mixed with one part, by measure, of a similar solution of the sulphate in a solution of Glauber's salt; the second consists of the same quantity of the solution of sulphate of copper, with the addition of one part, by measure, of a solution of the sulphate in a solution of sulphate of zink. There are, however, other proportions; for instance, equal parts, by measure, of the various solutions which afford satisfactory results; indeed, a simple solution of sulphate of copper in a solution of Glauber's salt, will afford an extremely malleable copper, which, when as much as half a line thick, is perfectly flexible, and presents a very even surface."

* * * *

"Occasionally, however, the two copper plates, thus prepared, adhere together so firmly that there is no possibility of separating them; but this difficulty is altogether obviated by the following process, which was first communicated by me to the Academy of Sciences, at their meeting of the 11th December, 1841.

"If we form a concentrated solution of common salt, and dissolve chloride of silver in it, (this is done by adding thereto a suitable quantity of a solution of nitrate of silver, shaking the precipitate well up in the fluid, and then letting it settle,) and into this liquor dip a clean strip of copper, it will be observed that, in from ten to fifteen minutes, there forms upon the surface thereof an infinitely thin film of firmly adhering metallic silver, so thin that on washing the plate and drying it with a towel, and rubbing it with a piece of wash leather, it presents the appearance of copper again.

"A similar coating of platina may be obtained by adding to a similar solution of salt (till the liquor assumes a pale wine-yellow colour) a few drops of a solution of platina, as neutral as possible. About one-eighth of an ounce of the solution of platina is required for a pound of the solution of salt. It takes about two hours for the film of platina to form completely upon the copper plate; but it adheres as well as the silver, if not better. In order to clean properly the plates thus coated, they are to be laid for five or six minutes in dilute muriatic acid, and then washed in warm water. If, when thus washed, they assume a bluish or yellowish hue, they must be again dipped in the diluted muriatic acid, and washed in cold water. The deposition of this film of silver or platina is very materially influenced by the quality and the nature of the copper surface; but it is precisely upon this galvanic copper, owing to its purity, that these films are thrown down in the most perfect state; and, as they form most readily upon smooth surfaces, they prevent the plates from growing together at the very spot where their tendency to adhere is the greatest. Anything approaching a modification in the copy is out of the question by this process; for, strictly speaking, these films are not coats upon the copper, but rather they replace a portion of that metal from the surface of the plate, inasmuch as there is an interchange between the atoms of platina or silver in solution, and those of the copper.

* * * *

"From the power of the currents depends the facility with which the plates may be separated, when the silver or platina is used, or whether, when neither of those substances are employed, the plates can be parted at all, or not."

THE "IMPROVED PROPELLER"—(CURRENT VOL. P. 280.)

Sir,—In No. 1159 of your valuable Magazine, p. 280, your correspondent, "P. P." has given a plan and description of an *improved propeller*.

I beg leave, through the medium of your journal, to invite your correspondent, "P. P.," to see a propeller-wheel, which I constructed more than eighteen months ago, *just upon the principle of the pitch of the blades gradually increasing to their*

extremities, exactly in the manner proposed by your correspondent, and which invention I patented the 15th of June last. This wheel may be seen at No. 9, Howard-street, Norfolk-street, Strand.

I have the honour to be,

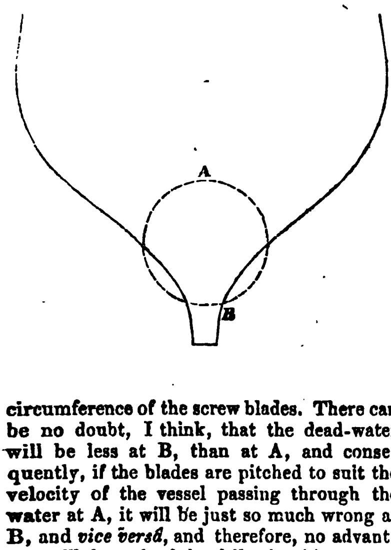
Your most obedient servant,

F. Rosenborg.

9, Howard-street, Norfolk-street, Strand, November 1, 1845.

Sir,—If I understand the improvement of the screw propeller recommended by your correspondent, "P. P." (No. 1159,) it appears to me that he has fallen into an error, inasmuch; as the amount of after-current (or dead water) is not the same at all *heights* of the stern post.

Let the following diagram represent the stern of the vessel, and the dotted circle the



circumference of the screw blades. There can be no doubt, I think, that the dead-water will be less at B, than at A, and consequently, if the blades are pitched to suit the velocity of the vessel passing through the water at A, it will be just so much wrong at B, and *vice versâ*, and therefore, no advantage will be gained by following his recommendation of "increasing the pitch of the blades from the centre to the circumference."

I am, Sir, your old subscriber,

T. W.

Esher, Surrey, October 30, 1845.

Sir,—In the last Number of your valuable Magazine, there is a description of a *new* (?) propeller, and in a postscript, the reader is referred to Appendix D, of Tredgold, for a sketch, showing the after current of a vessel. If your correspondent had read this Appendix through, he would have found at page 62, a very accurate and full description of this same propeller, which description also appeared in your Magazine, vol. xxxvii., page 180. Now, if your correspondent, "P. P.," had not been what I subscribe myself, he would not have troubled you and the readers of the *Mechanics' Magazine*, with the article alluded to. Yours,

Novice.

Blackwall, October 27, 1845.

LIEBIG'S PATENT MANURES.

We have had a great many enquiries respecting the nature of these manures, and we are glad to be at length enabled by the enrolment of the learned and distinguished inventor's specification, to gratify the prevailing curiosity on the subject. The patent for them was taken out, on Dr. Liebig's behalf (April 15, 1845) in the name of Mr. James Muspratt, of Liverpool. For ourselves, we must confess, (in all proper humility, of course,) that we are anything but overwhelmed with the value of the great Giessen Professor's revelations. We can discover nothing in his specification which was not well known before; and see much in it which is calculated rather to perplex, than enlighten the "agricultural mind."

The Specification.

To all to whom these presents shall come, &c., &c.—It has been ascertained, that the growing of any crop on land in a state of cultivation, and the removing and consuming of such crop wholly from the land where it was grown, takes away certain mineral compounds; and it has been suggested by Professor Liebig, that in cultivating land and applying manure thereto, that the manure should be such as to restore to the land the matters and the quantities thereof, which the particular plants have abstracted from the soil during their growth. It has been observed in the chemical examination of marls and vegetable ashes, that the alkaline carbonates and the carbonate of lime can form compounds, the solubility of which depends on the quantity of carbonate of lime contained in the particular compound. It has further been found, that the said alkaline carbonates can form alike compound with phosphate of lime, in which the carbonate of potash or soda is partly changed into phosphate of potash or soda.

Now, the object of this invention is to prepare manure in such manner as to restore to the land the mineral elements taken away by the crop which has been grown on and removed from the land, and in such manner, that the character of the alkaline matters used may be changed, and the same rendered less soluble, so that the otherwise soluble alkaline parts of the manure may not be washed away from the other ingredients by the rain falling on the land, and thus separating the same therefrom. And it is the combining carbonate of soda or carbonate of potash, or both with carbonate of lime, and also the combining carbonate of potash and soda with phosphate of lime, in such manner as to diminish the solubility of the alkaline salts to be used as ingredients for manure (suitable for restoring to the land the mineral matters taken away by crop which which may have been grown on and removed from the land to be manured,) which constitutes the novelty of the invention.

I would here state, that although the manures made in carrying out this invention will have various matters combined with the alkaline carbonates, no claim of invention is made thereto separately, and such materials will be varied according to the matters which the land to be manured requires to have returned to it, in addition to the mineral substances above mentioned. The quantity of carbonate or phosphate of lime, used with carbonate of soda or potash, may be varied according to the degree of solubility desired to be obtained, depending on the locality where the manure is to be used, in order to render the preparation less soluble, in localities where the average quantity of rain falling in the year is great; but as in practice, it would be difficult to prepare manures to suit each particular locality with exactness, I shall give such average preparation as will suit most localities. And as lands differ very greatly, it would be impossible to give directions in this specification for making manure according to this invention, which would produce the best results on all soils, I shall therefore only give such average preparations as will suit most soils as manure, and I will afterwards give such information as will enable parties desirous of applying the invention under the most advantageous circumstances to have manure manufactured for their particular cases. In making manure according to the invention, I cause carbonate of soda or of potash, or both, to be fused in a reverberatory furnace, such as is used in the manufacture of soda-ash, with carbonate or phosphate of lime, (and with such fused compounds I mix other ingredients as hereafter mentioned,) so as to produce manures; and such composition, when cold, being ground into powder by edge stones or other convenient machinery, the same is to be applied to land as manure. And in order to apply such manure with precision, the analysis and weight of the previous crop ought to be known with exactness, so as to return to the land the mineral elements in the weight and proportion in which they have been removed by the crop.

Two compounds are first prepared, one or other of which is the basis of all manures, which I shall describe as the first and second preparations.

The first preparation is formed by fusing together two or two and a half parts of carbonate of lime with one part of potash of commerce (containing on an average sixty carbonate of potash, ten sulphate of potash, and ten chloride of potassium or common salt in the hundred parts,) or with one part of carbonate of soda and potash, mixed in equal parts.

The second preparation is formed by fusing together one part of phosphate of lime, one part potash of commerce, and one part of soda ash.

Both preparations are ground to powder; other salts or ingredients in the state of powder are added to these preparations and mixed together, or those not of a volatile consistency may be added when the preparations are in a state of fusion, so that the manure may represent as nearly as possible the composition of the ashes of the preceding crop. This is assuming that the land is in a high state of cultivation; but if it be desired to grow a particular crop on land not in a high state of cultivation, then the manure would be applied in the first instance suitable for the coming crop, and then in subsequent cases, the manure prepared according to the invention would, as herein described, be applied to restore to the land what has been taken therefrom by the preceding crop.

Preparation of Manure for Land which has had a Wheat crop grown on and removed therefrom.

Take of the first preparation six parts by weight, and of the second preparation one part, and mix with them two parts of gypsum—one part of calcined bones—silicate of potash, (containing six parts of silica)—and one part of phosphate of magnesia and ammonia.

And such manure is also applicable to be used after growing barley, oats, and plants of a similar character.

Preparation of Manure for Land which has

had a crop of Beans grown thereon, and removed therefrom.

Take fourteen parts by weight of the first preparation; two parts of the second preparation, and mix them with one part of common salt, (chloride of sodium,)—a quantity of silicate of potash, (containing two parts of silica,)—two parts of gypsum, and one part of phosphate of magnesia and ammonia.

And such manure is also applicable for land on which peas or other plants of a similar character have been grown and removed.

Preparation of Manure for Land on which Turnips have been grown and removed therefrom

Take twelve parts by weight of the first preparation, one part of the second preparation, one part of gypsum, and one part of phosphate of magnesia and ammonia.

And such manure is also applicable for land where potatoes or similar plants have been grown and removed.

I would remark that I have selected the above cases, because they represent the chief of the products cultivated in this country; and in doing so, I have given such average preparations as will be beneficial in most, if not in all cases, as manure, to be used after the different crops mentioned, but manures may be prepared according to the invention for other plants than those mentioned; and if desired, manures may be made with greater exactness for those plants which have been mentioned for particular cases, if the matters of which the plants are composed and the quantities are first ascertained, by burning the plants and analysing the ashes, and then combining the manure according to the analysis. The manure so made is to be applied to the land in quantities, as great or greater than the quantities of the elements which have been removed by the previous crop. It should be stated that, where the straw of wheat and other similar plants, which require much silicate of potash, is returned to the land as manure, that is considered to be the best means of restoring the requisite silicate of potash to the land; in which case, in preparing the manures above mentioned, the silicate of potash would be omitted.

Having thus described the nature of the invention, and the manner of performing the same, I would wish it to be understood, that what I claim, is the preparing and applying in the manufacture of manure, carbonate of potash and carbonate of soda with carbonate and phosphate of lime, in such manner as to render the alkaline salts in manufactured manure less soluble, and therefore less liable to be washed away by rain before they are assimilated by the growing plants.

In witness, &c.

JAMES MUSPRATT.

Enrolled, October 15, 1845.

BAROMETRICAL PRESSURE.

Sir,—It was with much satisfaction I perceived from the Report of Sir John Herschel's address at the last meeting of the British Association, that the Antarctic voyage of Sir James Ross has ascertained that, a permanently low barometric pressure exists in high south latitudes—a pressure less, by considerably more than an inch of mercury, than what is found between the tropics; because it supplies additional evidence of the truth of the principles laid down in my papers on the action of the atmosphere; the action of light and atmosphere, and the distribution of the atmosphere; the action of light and air, and the distribution of the atmosphere; the action of air, and on light; inserted in the *Mechanics' Magazine* at page 239, vol. xxvi.; page 59, vol. xxvii.; p. 171, vol. xxx.; p. 277, vol. xxxiv.; p. 405, vol. xxxvii., and p. 354, vol. xl., and establishes the truth of what, before the sailing of the Antarctic expedition, I had maintained on principle. In these papers, some of which were published a year or two before the Antarctic expedition under Sir James Ross sailed from England, it is shown that the distribution of the atmosphere over the earth's surface is effected and regulated by the earth's rotation; that the atmosphere is accumulated at the equator and within the tropics by that rotation; where, in consequence of the accumulation, its density and pressure are greatest; and that they gradually diminish thence towards the poles.

And here, perhaps, I may be allowed to state, that the papers above mentioned develop a new, and I am sure a true, philosophy, which is exercising, and will exercise, greater and more beneficial influences on the destinies of man than any which have hitherto affected them—the influences of the sacred Scriptures alone excepted.

Remaining, Sir,

Yours with much respect,

G. WOODHEAD.

Old Hall, Mottram, November 4, 1845.

SCREW PROPELLING AND THE "BEE" EXPERIMENTS—SHORTER'S AND TAYLOR'S PATENTS.

Sir,—Having with pleasure read the remarks of an officer of the Royal Naval College, Portsmouth—towards the class to which he belongs, as a body, I entertain the most profound respect,—I am induced to hope that I shall be pardoned for stating a few interesting facts. Being the surviving partner of the late Mr. Edward Shorter, machinist, who was the original inventor of the ship's propeller, and who, of his own, mine, and other gentlemen's money, expended upwards of twenty thousand pounds to bring it to that state of perfection, such as it was, at his death, which took place February 4th, 1836, leaving two married daughters. After devoting near half a century to the study of this, to him, all-engrossing subject, and to show the passion strong, even in death, he died with a flat blade firmly grasped in his hand. His favourite acting model, with his various drawings, &c., I have in my possession, with such information as he was pleased to impart during an intimacy of seven years.

Since that period I have followed it up, according to my means, with the same indefatigable zeal, and shall continue to do so until the last moment I exist.

With respect to the trial in H. M. S. *Bee*, when the paddles, as per dynamometer, appeared to have the advantage, I can only say, with a pair of flat blades, made according to my patent, dated May 1st, 1838, I could have produced the same results to an ounce as by the paddle wheels.

It is not generally known by what a beautiful, mathematical, geometrical, and unerring rule, the power and speed of the flat blades can be calculated upon to perform before they are immersed in the water, which cannot be accomplished with the curved blades, all forms of which I most emphatically say are unphilosophical, and will never accomplish, without great area of surface, anything like the flat blades.

And which, let me ask any naval gentleman, would be the most desirable, when under canvass, a propeller of light weight, small area of surface, &c., to curved blades, which must be of necessity everything the reverse?

And when I add that I am the only patentee of the method of shipping and unshipping the blades inboard, through a well-hole, channel, or trough, fitted with slides, or grooves, and covered with a hatch, between the stern posts, so as to lift up and haul the propellers inboard, however blowing the weather, or whenever occasion may require to repair or go under canvass, similar on principles to the sash of a window, I think it will appear obvious to all disinterested parties, that I have given the subject every possible consideration.

From, esteemed Sir,
Yours very respectfully,
J. J. O. TAYLOR,
Eldest son of the late Mr. Joseph Taylor, of Dronfield Academy, Derbyshire.

Tiger Tavern, Tower Dock, City,
November 5th, 1845.

RECENT AMERICAN PATENTS.

[Selected and abridged from Mr. Keller's Reports in the *Franklin Journal*.]

AN IMPROVEMENT IN THE SMELTING FURNACE. *Leman Bradley*.—This consists in dividing the stack into two, three, or more compartments, by means of partitions, extending from the top to a point a little above the entrance of the blast. Into one of these divisions the coal only is put, and the usual charge of ore, coal, &c., in the others; and that part of the hearth which is below the coal division is elevated above the other portion, that the coal may be kept up to the blast, and permit the melted metal to descend below it. The patentee sums up the operations and the advantages in the following words, viz.: "The greatest part of the charge being put in the compartment next the headstone, the metal will rest on the boshes, and will not come down faster than it is melted by the blast—the principal part of which comes in through the body of coal in the chamber, from the blow-pipe; the combustion being thereby rendered perfect before the blast reaches the metal, a great saving of fuel is effected, and a better quality of iron is produced. The damper over the coal chamber is kept down during the operation, and the gases are allowed to escape through the chambers on the opposite side of the partition. The fuel in the chamber rests on the hearth, and cannot fall much below the blast. A small blast can also be thrown in on the opposite side of the furnace to the main blast, which is regulated at pleasure."

Claim.—"Having thus fully described

my improvements, what I claim therein as my invention, and desire to secure by letters patent, is dividing the interior of the furnace stack into two or more compartments, by partitions, which descend nearly to the bosh of the furnace—the bosh being the same as that of the common blast furnace, except the elevated hearth; the whole being constructed, arranged, and combined, in the manner and for the purpose herein set forth.

"I also claim the hearth, raised above the common hearth, and with the bosh, so that the melted metal will fall below the blast, and the fuel be retained up to the blast, as set forth."

An Improvement in Saw Mills. *Calvin Stigleman and Austin Seely.*—This saw is to be worked without the usual saw-gate for straining it, this being effected by the elastic force of steam. The two ends of the saw are connected each with a steam piston, the lower one being much larger than the upper one, and the two cylinders in which they work are connected together by a steam pipe, so that the pressure of steam acting on the two pistons strains the saw, and it is carried down to cut by reason of the greater capacity of the lower piston than the upper one.

Claim.—"What we claim as our invention, and desire letters patent for, is the adaptation and application of the upper cylinder in straining and running of saws without a frame, and for all other purposes for which it can be used to advantage, as represented in the drawing herewith transmitted."

An Improvement in Safety Switches for Railroads. *Gustavus A. Nicolls.*—*Claim.*—"What I claim as my invention, and desire to secure by letters patent, is a safety turnout switch, embodying the combined use of inclined planes and guides to elevate and slide the wheels on the tracks, and the combination of these planes and guides with the safety bars."

This improvement, as indicated in the above claim, consists in the employment of two parallel bars attached to, and moving with, the switch; so that, when the switch has been shifted and put in connexion with the turn-out rails, they are in line with the rails of the main track; and, in the event of neglect on the part of the attendant to replace the switch, a car from the main track will run on to these parallel bars, which are, at their fixed end, connected with the main track by means of inclined planes and guides, so arranged as to elevate the flanch of the wheels (which are outside the track) over the rail, and guide the whole of them to the line of the track, and thus prevent the cars from running off.

An Improved Mode of Feeding and Turning the Rod in Nail-cutting Machines. *Caleb Isbister.*—*Claim.*—"What I claim as my invention, and desire to secure by letters patent, is the mode of feeding the nail rod, or plate, to the cutters, by means of a rotating hollow shaft, or tube, operating substantially in the manner described, whereby the rod, or plate, is turned over at each operation. I claim, also, the combination of the parts which communicate the progressive feeding motion to the nippers, by the up-and-down movement of the forward end of the rotating hollow shaft, or tube, as described; and I claim the combination of parts by which the nippers are brought back, and the machine stopped. And, finally, I claim the combination of parts by which the motion is communicated from the nail machine to the rotating hollow shaft or tube."

As all who are acquainted with this branch of manufactures know well, one end of the nail is thicker than the other, it becomes necessary to reverse or change the inclination of the rod at each time a nail is cut, to make the head end from opposite sides at each successive operation. By hand the former course is pursued, which prevents the action of the cutters from bending the rod; but by the machines heretofore employed or essayed for this purpose, the inclination only has been changed; and the object of the present improvement is to effect the presentation of the rod in the same manner as by hand, and thus prevent the tendency to bend the rod.

An Improvement in the Furnace for the manufacture of Malleable Iron directly from the Ore. *Claude S. Quillard.*—*Claim.*—"I claim the combining of one or more reverberatory furnaces with a chimney, or stack, containing in its lower part a deoxidizing furnace, which I have denominated a crucible, in such manner that the said crucible and the contained ore and carbonaceous matter shall be heated by the flame and escape heat from the reverberatory furnace, or furnaces, by an arrangement and combination of respective parts, substantially the same with that herein made known. Secondly. I claim the manner of agglutinating the mass of deoxidized iron, previously heated in the reverberatory furnace, by submitting the same to pressure within a cylinder, or other formed receiver of any suitable construction, by means of a screw lever, or other press, preparatory to its being acted upon by the hammer, or by rollers. I am aware that puddle balls, or loops, have been squeezed, and worked, by means of a vibrating lever, upon a flat table; but this is an operation which could not be applied to the iron as prepared by me, as, instead of agglu-

tinating, it would separate its particles—its pressure in a contained vessel being an essential part of my process."

ELECTRICITY, MAGNETISM, AND LIGHT.

The following letter from Sir James South, appeared in the *Times* of Wednesday last.

Sir,—With great pleasure do I communicate to you, that in addition to other scientific discoveries of the highest order made during the last 40 years in the laboratory of the Royal Institution, which have greatly exalted the scientific glory of our country, and have entitled that institution to the gratitute of mankind, Mr. Faraday, its Fullerian Professor of Chemistry, yesterday announced to the members present that in the prosecution of his researches in electricity and magnetism, he had succeeded in obtaining *experimentally* what he had long sought for—namely, " the direct relation of electricity and magnetism to light."

The details of his experiments, which exhibit the magnetization of light, the illumination of the lines of magnetic forces, and a *new* magnetic condition of matter, will be presented to the Royal Society immediately; but the public illustration of the several phenomena will be deferred till the approaching evening meeting of the members of the Royal Institution.

Knowing that you will be proud of first promulgating these important facts in the columns of the *Times*,

I remain, Sir, your obedient servant,

J. SOUTH.

Observatory, Kensington, Nov. 4.

NOTE ON THE HISTORY OF ELECTRO-CULTURE.

[From a Letter to the Editor of the *Edinburgh Courant*, by A. Coventry, Esq.]

To Dr. Forster's experiments at Findrassie we may trace all the present excitement; and it will give some idea of its extent when I mention that, besides a great number of trials now making in Scotland, in England there are 700 acres, and part of the Chiswick Gardens, under experiment. But Dr. Forster's idea of applying electricity to vegetation was far from being a new one, although it was hailed by many as something unheard of. In truth there had been a very great deal written on the subject. Beginning with a person of the name of Maimbry, in this town, in the year 1746, it had engaged the attention of Jallabert, Sennebier, Bertholet, Du Hamel, Nairne, Van Marum, Muschinbrock, Carmois, Ingenhouz, Cavallo, De Candolle, Davy, Pouillet, Ellis, Becquérel, Noad, and a dozen more whom I could mention. The result to which it was generally understood that they had come was, that electricity of moderate force exercised no influence on vegetation, and that a strong charge was fatal. No doubt the Abbé Bertholet (who wrote in 1783) had taken a different view, with the support of Nollet, Jallabert, Muschenbrock, and Du Hamel. But the opinions of Ingenhouz and Cavallo, and more lately of Pouillet and Becquérel prevailed; and these were, that " the most impartial, diversified, and conclusive experiments have shown that electrization does neither promote nor retard vegetable life." I quote the words of Cavallo, (vol. iii. p. 357;) but the same sentiment is to be found in Becquérel, the highest of all authorities; and in his fourth volume, p. 185, he explains that the action of galvanism, if it be energetic, cannot but be injurious, since it must destroy the tissues, and alter the natural constitution of the juices. He had formerly shown that whatever the influence of electricity may be o animals, the tissues of plants are unlike the nerves, and will not, like them, contract, and they are besides bad conductors of electricity, as a dead leaf shows. If, therefore, it acts in their case at all, it must be mechanically, by affecting the capillary action, or chemically, by changing the juices; and much change either way would appear to be hurtful. *

THE LEVEL OF THE SEA.

It has been customary for seamen and others to estimate and establish the height of objects above the *level* of the sea; but a moment's consideration will show that the said level is rather a difficult datum to get at. Owing to the resistance offered by the shore, together with the angle at which the current impinges on the land, the rise of tide in ports is mostly in excess of that in the offing. Now it is true that the usual method of arriving at a mean level by the method called the half-tide mark, if deduced from the averages between the highest and lowest spring-tide, is the most obvious for relative purposes; but an absolute and permanent level of the sea is still a desideratum. There are large seas, where the waters hardly rise, and others where they flow to a height of 60 or 70 feet, as in the Bay of Fundy. On our own coasts we find a rise of 45 feet in the estuary of the Severn, and at Lowestoffe only 5; at London it is 20 feet, at Portsmouth 18, at the Needles 9, and at Milford Haven 30; while across the Channel, we have 22 feet at

* It is a real Comfort to see all [illegible] Becquerel [illegible]

Brest, 45 at Jersey, and 54 at Mount St. Michael. Such monstrous inequalities show the difficulties to be grappled with; but still we think the object far from unattainable; and the circum-establishments, or stations, recently planted around Ireland, offer the means of solving this important practical question. The phenomena should be watched for on the various coasts of continents and islands, with a view of detecting the cause of the perplexing anomalies observed. We have as yet no absolute cognition as to why high water is attained at noon every day in several places in the Pacific, nor why the ebbing and flowing occurs in three hours at Panama. The north coasts of the South-Shetland Isles, Van Dieman's Land, New Ireland, and the Gulf of Tonquin, offer the phenomenon of but one flood-tide in twenty-four hours; while, as they tell the story, in the Strait of Euripus, which separates Negropont from Greece, the tides, during the first eight days of the moon, as well as from the fourteenth to the twentieth day, ebb and flow regularly four times in twenty-four hours; while during each of the other days, they ebb and flow with great force from eleven to fourteen times a day, though with but slight elevation and depression. Other records state the Euripus to have had seven tides in the twenty-four hours; and they further tell us that Aristotle, chagrined at being unable to divine the cause of so striking a singularity, leaped into the stream, and was drowned, exclaiming, "You shall contain me, since I cannot comprehend you." This, if Procopius speaks truly, was a sad mishap, since, had he cleared up certain irregularities dependent upon the winds and the conformation of the Eubœan gorge, he would have found that the stream in question only ebbs four times a day; but we own that we place no greater belief in this story, than we do in that which makes the Stagirite poison himself—he always branding suicide as a shameful and cowardly act.*

The Tonquin tide above alluded to was communicated by Mr. Davenport, in a letter which is inserted in the *Philosophical Transactions*, Vol. XIV., page 677, together with a theory upon it by Halley. Newton's explanation of the phenomenon consisted in supposing that the tides at this place are compounded of two tides, which arrive by different paths, one six hours after the other. But there is no end of singularities. Within the Strait of Magalhaens, westward of the Second Narrow, it is high water—according to Capt. Fitzroy—at about $4^h\ 40^m$, and the tide rises six feet; but eastward of the First Narrow it is high at $1^h\ 30^m$, and the tide rises forty feet: in one case the sea being twenty feet above its natural level, and in the other only three!

The difficulties and apparent inconsistencies here enumerated have furnished many addle-headed theorists with froth to bespatter the Newtonian doctrine of the tides; and they have mistaken the applause of others still more sciolous than themselves as a confirmation of merit. We are too charitable to mention names; but to the two or three choice philosophists who still remain, and trouble the gentle public with their nonsense for the plaudits of a few dunces, we recommend the golden lines of Churchill:—

"While such sad mongrels hold the moon at bay,
Apes grin, wolves howl, hogs grunt, and asses bray."

—*United Service Magazine.*

* Aristotle had retreated from Alexander's court in his old age, to avoid the consequences of offending a son of Jupiter-Ammon. Few sovereigns would choose to write the following missive in the present advertising days:—"Alexander to Aristotle, wishing all happiness. You have done amiss in publishing your books on the speculative sciences. In what shall I excel others, if what you taught me privately be communicated to all? You know well that I would rather surpass mankind in the more sublime branches of knowledge than in power. Farewell!" This letter on the *acroatic* works was written in the turmoils of a stirring campaign; for it was soon after the battle of Gaugamela, and while the pursuit of Darius was hot.

EXTENSION OF AMERICAN PATENTS.

Circular.

Patent Office, Washington,
June 21st, 1845.

The undersigned, constituted by law a board to decide upon applications for the extension of patents, have adopted the following suggestions and rules, for the benefit of those persons who may hereafter apply for extensions.

The questions which arise on each application for an extension are—

1. Is the invention *novel?*
2. Is it *useful?*
3. Is it *valuable* and *important* to the public?
4. Has the inventor been *adequately remunerated* for his time and expense in originating and perfecting it?
5. Has he used due diligence in introducing his invention into general use?

The first two questions will be determined upon the result of an examination in the Patent Office; as will also the third to some extent.

To enable the board to come to a correct conclusion in regard to the third point of inquiry, the applicant should, if possible, procure the testimony of persons disinterested in the invention, which testimony should be taken under oath.

In regard to the fourth and fifth points of inquiry, in addition to his own oath, showing his receipts and expenditures on account of the invention, by which its value is to be ascertained, the applicant should show, by the testimony of disinterested witnesses on oath, that he has taken all reasonable measures to introduce his invention into general use, and that, without default or neglect on his part, he has failed to obtain from the use and sale of the invention a reasonable remuneration for the time, ingenuity, and expense bestowed on the same, and the introduction thereof into use.

The report of the examiner upon the novelty and utility of the invention, will be ready fifteen days before the day appointed for the hearing, which will be open for inspection at the Patent Office; copies of which will be furnished to all parties interested, if desired, on payment of the usual fees for copies.

In case of opposition by any person to the extension of a patent, both parties may take testimony, each giving reasonable notice to the other of the time and place of taking said testimony, which shall be taken according to the rules prescribed by the Commissioner of Patents in cases of interference.

All arguments submitted to the board must be in writing.

In conclusion, the undersigned would remark, generally, that a monopoly of his invention is secured by law to the inventor for the term of fourteen years. This is done with a view to compensate him for his time and expense in originating and perfecting it. At the end of the time for which his patent runs, his monopoly should cease, and the invention become public property, unless he can show good reasons to the contrary. The presumption is always against his application; and if he cannot show that his invention is novel, useful, valuable and important to the public, and that, having made all reasonable effort to introduce it into general use, he has not been adequately remunerated for his time and expenses in discovering and perfecting it, the board cannot grant an extension.

James Buchanan, Sec. of State.
Edmund Burke, Com. of Patents.
F. Barton, Sol. of the Treasury.

NOTES AND NOTICES.

Diagonal Skinning.—The *Teazer*, steam-vessel, building at Chatham, is completed in her frame, and the shipwrights are about commencing the planking of this vessel. The skinning of the vessel is diagonal, with three thicknesses of oak, the outside fore and aft being two inches thick, and the inner skinning one and a half inch. This system of skinning diagonally is the first of the kind done in any of the yards.

New Fire-engine.—A new fire-engine, made by Mr. Farmer, of Birmingham, was exhibited at the Fire Police station, Temple-court, Liverpool. The engine, which is very simple in its construction, is capable of throwing eighty gallons per minute to an altitude of forty feet; six men are required to work it. It consists of a cistern about four feet long and two wide; the water is drawn from the cistern by what the inventor calls the rotatory engine, which is simply a wheel of four fans, made to revolve in a circular box with great rapidity; the water is by this means drawn from the engine by one pipe and delivered through another simultaneously. It will be useful for fires in hay ricks or houses; it would also be of use in cooling salvages, for which a rose-headed pipe is provided, distributing the water extensively; but it appears to want power for such fires as occasionally happen in this town.—*Liverpool Courier.*

A Geological Curiosity.—There is now in the possession of John Dimmock, Esq., a curiosity in the shape of a mass of manufactured Coral limestone, several inches in diameter, in which are firmly imbedded several Spanish dollars. It is a specimen of a treasure found by an American company, organised in Baltimore, on the wreck of the *San Pedro*, which was burnt and blown up Feb. 11, 1815, near the island of Cocho, on the coast of Venezuela, Central America. It is supposed that the ship had on board, when she was destroyed, several hundred dollars, a portion of which has been found by our enterprising countrymen, and brought away. They will probably become in good time masters of all the treasure. Only thirty years have elapsed since the vessel was sunk, and the specie which she contained scattered over the coral reefs and sands; yet the formation of the rock is perfect, consistiug of coral, sand, and shell, in which is also a piece of the wood-work of the ship. In this respect it will possess great interest for the geologist.—*Boston Journal.*

The Clock Manufacture in America.—The great extent to which this is carried, may be judged of, from the fact, that one single establishment, Jerome's, of Newhaven, turns out 50,000 clocks every year.

Deep Well.—The American papers mention an extraordinary spring of water in Missouri, about 50 miles north of Bateville, which has been sounded to the depth of 500 feet without reaching its bottom. The water flows with but little variation in quantity all the year. The quantity is estimated to be from 20,000 to 30,000 cubic feet per minute. The fall is rapid, amounting in distance of half a mile to 12 or 13 feet.

Air Churn.—The Bishop of Derry has invented an atmospheric churn. Instead of the present unscientific mode of making butter by churning, his Lordship accomplishes this measure by the simplest manner of forcing a full current of atmospheric air through the cream, by means of an exceedingly well devised forcing pump. The air passes through a glass tube connected with the air-pump, descending nearly to the bottom of the churn. The churn is of tin, and it fits into another tin cylinder provided with a funnel and stop-cock, so as to heat the cream to the necessary temperature. The pump is worked by means of a winch, which is not so laborious as the usual churn. Independently of the happy application of science to this important department of domestic economy in a practical point of view it is extremely valuable. The milk is not moved by a dasher, as in the common churn; but the oxygen of the atmosphere is brought into close contact with the cream, so as to effect a full combination of the butyraceous part, and to convert it all into butter. On one occasion the churning was carried on for the space of one hour and 45 minutes, and 11 gallons of cream produced 26lb. of butter.—*Globe.*

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1162.] SATURDAY, NOVEMBER 15, 1845. [Price 3*d*.

Edited by J. C. Robertson, No. 166, Fleet-street.

ROE'S PATENT IMPROVEMENTS IN THE MANUFACTURE OF GLASS PIPES.

Fig. 1.

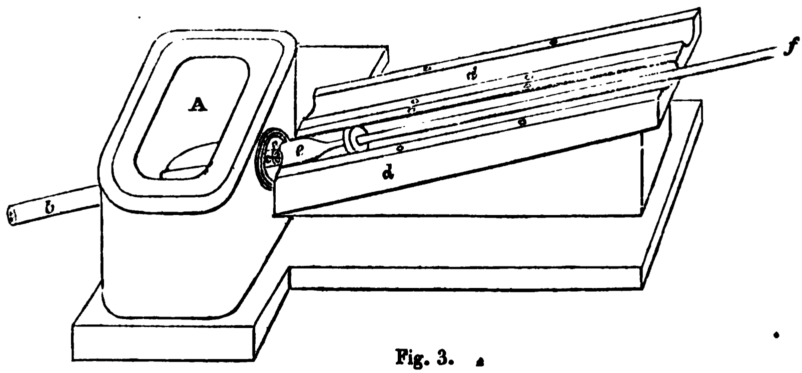


Fig. 3.

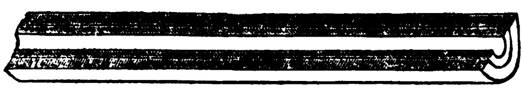


Fig. 4.

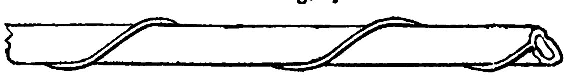


Fig. 2.

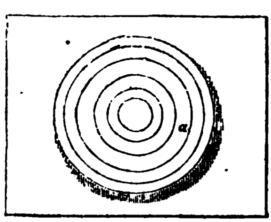
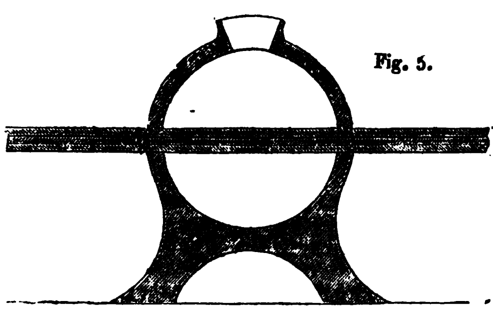


Fig. 5.



ROE'S PATENT IMPROVEMENTS IN THE MANUFACTURE OF GLASS PIPES.

[Patent dated April 22, 1845; Patentee, Freeman Roe, 376, Strand; Specification enrolled, October 22, 1845.]

When Sir Robert Peel brought forward his proposition for the emancipation of the glass manufacture from the combined thraldom of the exciseman and taxgatherer, he dwelt particularly on its applicability as a material for water pipes, as one among many reasons for the measure. He had "read in the *Courier de l'Europe*, that in France they were now manufacturing glass pipes for the conveyance of water, which cost nearly 30 per cent. less than pipes manufactured of iron." Had the Premier made enquiry of persons practically acquainted with the manufacture, he would have found that it is much easier to talk about employing glass for water pipes, than to tell how such pipes are to be made—that is, pipes of the same length as those usually made in iron, and of like uniformity of bore and substance. We are certain that he could not have produced a single glass pipe made in England of 5 feet long and uniform bore and substance; neither do we believe—the authority of the *Courier de l'Europe* notwithstanding—that he could have searched all France and Europe through with any better success. The fact is, that to make pipes of such length and quality has hitherto exceeded the glass blower's art, as well in foreign countries as in our own, and whether fettered or not fettered by fiscal interference. One good effect, however, of the attention drawn to the subject by the Minister is, that this reproach (if so it may be called) is very likely to be soon removed. In this, as in other cases, the existence of a great want has been no sooner made known, than numbers of ingenious individuals have set themselves to work to supply it; and if the thing be not speedily achieved, we may be tolerably certain, that it is only because it is not within the limits of possibility. We have now before us the specification of one patentee, who states, that he can manufacture glass pipes "of any of the lengths usually required for such purposes, (conveyance of water and other fluids,) and of uniform bore and substance, or nearly so, and with joints adapted thereto, by which they may be as readily and directly connected as any other pipes;" and we have heard of some other patents being completed and in progress, having a similar object in view, and from which some further improvements may be reasonably anticipated.

The processes which Mr. Roe adopts, are thus described in his specification.

"In preparing the glass of which the pipes are to be made, and bringing it into the state fit for the purpose, I employ for the melting of the same a blast of hot atmospheric air, such as is commonly known in its application to the smelting of iron, by the name of the hot blast, and produced by passing the air through a hot chamber or chambers, before bringing it to the point of application. Or I employ an air-hydrogen jet or jets, similar to what is, or are employed in autogenous soldering; or I employ a hydrogen jet in combination with the hot-air blast, and I make use of the said air-hydrogen jet, or hot-air blast, or combination of the two, either exclusively during the preparation and manufacture of the glass as aforesaid, or as an auxiliary or auxiliaries only when very high degrees of heat are required. The manner of heating the air and of afterwards conducting and applying it to the smelting furnace depends in some measure upon circumstances, that is to say, whether it is applied to an ordinary glass furnace, or whether a furnace is purposely constructed. When applied to an ordinary glass furnace, the air having been collected in a large gasometer, is then forced out by pressure through a heated flue or chamber, or in any other convenient manner, and made to circulate through such heated flue or chamber, until its temperature is sufficiently raised, after which it is applied in a manner similar to that used for the hot blast in the smelting of iron. Means however should be adopted either for shutting out the access of the cold air to the furnace altogether, or admitting it at pleasure, which object is accomplished by the use of a door or doors, so placed as effectually when shut to keep out such draft or drafts. When a furnace is purposely constructed for the application of the hot blast, it may be so formed as to leave no other draft, except only that from the hot blast, a door being left for merely supplying fuel to the furnace, either at the front or side. The apparatus for making the glass into pipes is represented in the accompanying engravings. Fig. 1 is a side view of an apparatus which I employ for the purpose of manufacturing pipes of large dimensions, and fig. 2 a front view: A, is a pot or cauldron made of fire-clay, or other suitable heat-resisting material; *b*, *c*, is a tubular

Fig. 7.

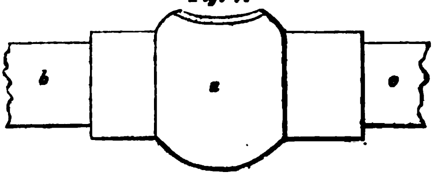


Fig. 8.

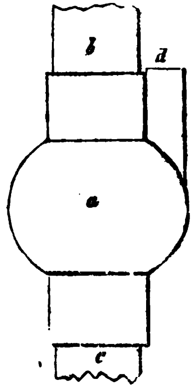


Fig 9

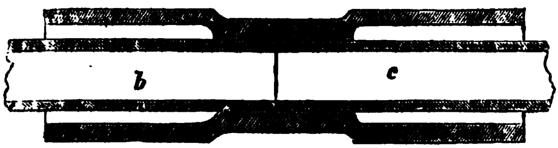


Fig 10

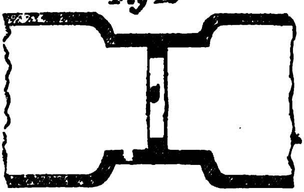


Fig 11

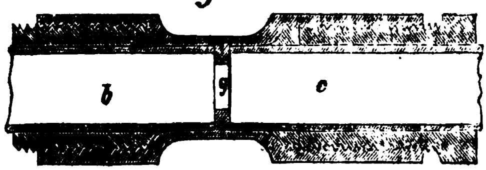


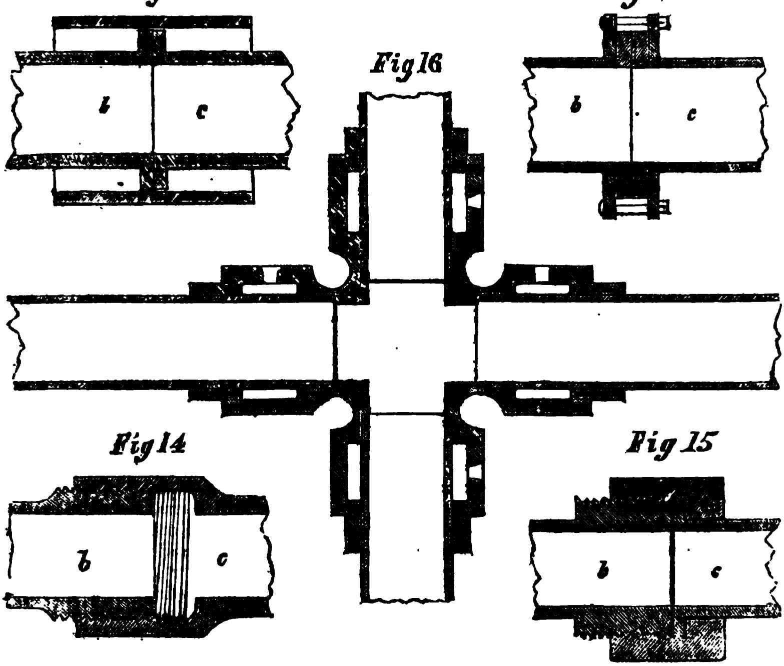
Fig 12

Fig 13

Fig 16

Fig 14

Fig 15



metal mandril (shown in section in fig. 3,) carefully coated with baked clay, which is passed through the pot A from back to front, the back orifice through which it passes being closed in around it, but the front orifice, *a*, being left open, and the mandril being so supported by suitable bearings at the back end, that it passes through the front orifice, exactly in the centre and without touching the sides, leaving room for the glass to flow all around it. The mandril is made a little smaller in diameter than the bore or hollow of the tube intended to be made, and the space left between it and the periphery of the front orifice *a*, should be as nearly equal, as may be, to the thickness desired to be given to the tube. The mandril is made hollow, in order that a blast of air may be directed continually, if necessary, through it by machinery applied to the end marked *b*, and situated at a convenient distance from the pot A, or by any other suitable means; *d d* is a tubular mould, consisting of two pieces connected by hinges, so that it can be readily opened or closed as required; *f* is a tubular rod, by means of which the pipe is drawn, which terminates at the inner end in an elongated cup, *e*, and has a disc raised upon or attached to it a little way behind the cup, which disc is of the diameter of the intended tube of glass. The pot, A, being supplied with a quantity of nearly fluid glass, an air-hydrogen jet is made to play upon the pot or upon its contents, either while in the pot or while issuing from it, so as to keep the same at any degree of temperature which may be required. The cup end *e*, of the long tubular rod, *f*, is then introduced into the orifice *a*, having been previously heated or prepared, so that molten glass will readily adhere to it. The rod is then drawn forward with a rotary motion, which can be easily given to it by hand, or by the other means hereafter described, which causes it to draw after it the heated glass into the mould, *d d*, which, as soon as it is filled is instantly closed, when the workman, by shutting a suitable valve, at the outer and open end, *h*, of the tubular rod *f*, causes the blast which is going on through the mandril, *b c*, suddenly to accumulate in the interior, and the glass thereby to assume the precise shape of the mould. The glass tube is then detached from the tubular rod *f*, and the mandril, *b c*, and taken to be annealed.

"*For bent tubes* a bent mould is required, and the operation of drawing is then best performed by hand; and by leaving an indentation, or indentations in the mould, requisite places may be obtained for applying the offsets or branches.

"*For straight tubes*, when drawn by machinery, any amount of rotary motion required can be given to the iron tube, *f*, by simply having a portion of its exterior, ribbed obliquely, as shown in fig. 4, and by then drawing such portion through suitable couplets, the rod and couplets forming together a sort of male and female thread, running obliquely.

"When the glass tubes require to be of small dimensions they are made as follows. Two iron tubes are connected by passing within them a third tube or rod, as represented in fig. 5. The compound tube thus formed is then passed through an open ball mould from side to side, through orifices which serve as rests for the rods, and are afterwards closed in, as shown in the figure. The mould is next filled with molten glass in the usual mode followed in casting glass, and is opened as soon as the glass has somewhat cooled. The ball of glass is then taken out and the inner iron rod withdrawn. The ball is next heated by the air-hydrogen jet, and after blowing and drawing it alternately for a number of times, with occasional heating (two workmen co-operating in the process) the work is completed by blowing in a tubular mould, the blast being given by a similar mechanical contrivance to that used for making the well-known moulded elliptical shades. Or a workman merely gathers a mass of heated glass upon the end of the tube, then rolls it in the usual way upon an iron plate, and after heating it by means of the air-hydrogen jet, a second workman assists in drawing out the tube by the aid of an iron rod, with a drop of melted glass at the end of it. The tube is then finished in a mould, the blast being given as in the last case, when much air is required.

"The modes I adopt for connecting the sundry lengths of glass pipes, so as to adapt them for the conveyance of water, or other fluids, are represented in figs. 7 to 16, (both inclusive) of the accompanying engravings. In fig. 7, *a* is a joint piece made of iron or brass, or any other suitable material for connecting two lengths of glass pipe, *b* and *c*, which piece is formed with a hollow enlargement in the central part of it for admitting the introduction of any useful cement, such as a mixture of resin, tallow, and silver sand, or of shell-lac and wax. The two ends of the pipes, *b* and *c*, are first warmed and coated with the cement. The joint piece, *a*, being also well coated with cement in its interior, is put on while still warm, and more cement poured in through the orifice, *d*, when it so surrounds the pipes *b* and *c*, near to, and for some distance from their points of junction, as to unite them on cooling, in a firm and substantial manner. Any running of the cement into the interior of the glass pipe is easily prevented, when the ends of the glass pipes are not quite true, by using a band of

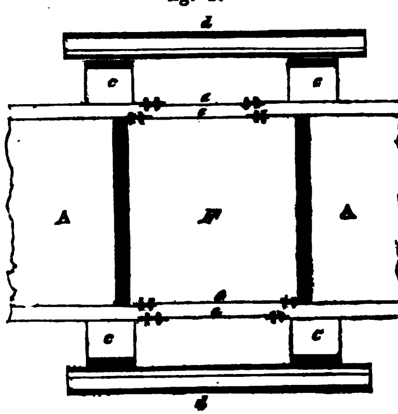
cotton, cloth, or tow. Fig. 8 is a modification of fig. 7, expressly adapted for connecting lengths of pipe, when such lengths have to be fixed vertically, for which reason it is convenient to have the lip or orifice, *d*, placed in a position different from that adopted in the preceding case. Fig. 9 is a sectional view of a joint piece which is so formed that it may be slipped over the pipes *b* and *c*, previously bound with cotton or cloth dipped into cement, and holds them tightly for some distance around the point of contact. The socket ends are next packed with tow, cotton, or other suitable material, dipped into melted cement, and rammed home. Fig. 10 is a joint piece, having within it a stop or check, *g*, placed about midway, which prevents either of the pipes from being thrust too far while fixing; in other respects the interior is of the same shape as fig. 9. Fig. 11 differs from fig. 9 in having a thread in its interior so as to admit of the use of a screw piece, instead of packing only, the screw piece being attached to the end of the glass pipe; the joint is made with a washer, or the screw piece may be loose, so as to form a kind of stuffing-box, as shown at the end, *c*. In fig. 12, the pipes *b* and *c* have flanges, which serve as a guide to a joint piece, quite plain, the ends of which are caulked as before described. Fig. 13 shows another mode by the aid of metal bolts, washers, and flanges, in addition to those left in the glass pipe; the bolt holes being drilled or made in the metal flanges only. In fig. 14, the male and female screws are made direct in the glass pipes during the operation of moulding, so that one pipe may be screwed into another, and the joint made with a link or washer. In fig. 15, the small screw and flange only are formed in the pipes *b* and *c*, and also by blowing and moulding; the rest is of metal. Fig. 16 represents the mode of forming off-sets, when it is found convenient to make them in such way, instead of leaving them in the operation of blowing and moulding by making a suitable hole in the mould."

SUBMARINE RAILWAYS—MR. DE LA HAYE'S PLANS.

Respected Friend,—Having explained the principles on which submarine railways might be constructed, I will proceed to explain a few of the details as regards the most complicated part of the work. I do not pretend to have brought the different operations to the perfection which may be attained in a work which admits of so many modifications; the following, however, are the results of nearly three years' attention to the subject; experience, would of course suggest such improvements as would tend to simplify the work in the details; perhaps, so as to render the construction of submarine railways a work hardly more difficult than a railway on land.

I will first allude to the mode of connecting the divisions of the tunnel temporarily under water. Previous to placing the divisions below, I would fasten a bandage or rim of wood outside, at each end; this rim would be 1 foot thick and the same in width, and formed of the shape of the outer circumference of the tunnel. After being fastened by means of bolts, I would nail several layers of tarred canvass on the wood. The divisions being sunk on their position below, end to end, and as close to each other as possible, I would prepare a sheet of lead and one of copper, of a length equal to the outer circumference of the arch; these sheets of metal being laid flat on aloft, the copper over the lead, I would place a sufficient number of pieces of wood across the metal; they should be 1 foot wide and 4 inches thick, and connected by means of hinges; and on each piece of wood I would place a thick plate of wrought-iron. It will be seen that the wood is intended merely as a medium of fastening the different sheets by means of bolts driven through the whole: this covering, which would be sufficiently wide to cover the space between the two divisions, would be thus of an immense strength, and yet could be bent on the arch; when completed, it should be let down on the ends of the two divisions, so as to rest on the rims of wood covered with canvass and tar. The principle will be seen in figure 1.

fig. 1.



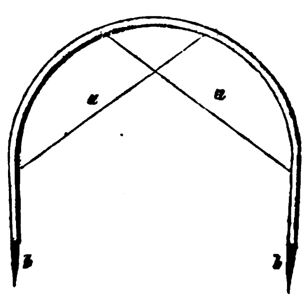
The proportions of the tunnel are not preserved, in order to show the metal and wood covering on a large scale. A A represent the ends of two divisions; *b b*, the temporary blockading frames of wood and iron; F, the bed of the sea between the divisions; *c c*, the wooden bandage or rim; *d d*, the covering of lead, copper, &c. The covering, *d d*, being lowered on *c c*, two divers would descend below, to place it in its position; this, in fact, would be the only work for the divers, as regards connecting the divisions under water. As soon as the water was pumped from inside the divisions, the pressure without would be so tremendous that the covering, *d*, would be pressed on *c c*, as effectually as if it were screwed to the wood. Probably, however, some water would enter the tunnel through the smallest crevices, so that the pumps should be kept at work until the plates *e e*, were riveted so as to connect permanently the two divisions; the covering *d* might be afterwards removed, or perhaps it would be better to let it remain, as an additional security.

It will be seen that the operation of connecting the divisions will occupy only a short space of time, and that the work left for the divers would be very trifling; several divisions might be connected in one day by having everything requisite in readiness. By these means the submarine operations might be conducted only while the sea was perfectly calm, while the work would be rarely retarded, as during violent storms, the workmen could work inside the tunnel; thus forwarding every department of the work, such as laying down the rails, gas pipes, painting, &c., so that when the last divisions were connected the tunnel would be nearly finished.

Another operation of importance remains to be explained, that is, to sink the divisions near the shore, in the soil, to protect the building from injury during storms. This operation should also be executed rapidly, and with very little work under water. It would of course be impossible to excavate the soil previous to letting the divisions below; the divisions must therefore be sunk first in the earth and the soil excavated afterwards. I presume, that this object can be attained in a very short time, and at a very trifling expense, for gunpowder is considered a very cheap article; although, perhaps, some persons might object to such a quantity being used for constructing submarine railways, who would not object to a thousand times more being destroyed for a very different purpose: public opinion is, however, rapidly changing, and I presume, that if permission were given by the Government to construct a railway from Dover to Calais the gunpowder would be granted duty free: the object would deserve it, at any rate.

The divisions to be sunk in the earth should first be built simply as an arch, having neither floor nor platform outside, as in figure 2. These divisions should

fig. 2.



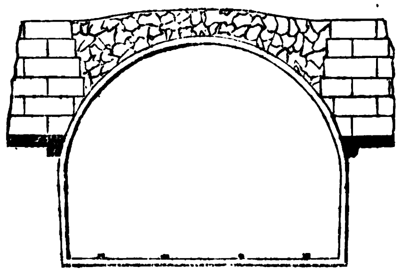
be strengthened by means of temporary iron bars, *a a*, placed at intervals of 10 feet apart; the two ends should then be temporarily blocked up with a framework of wood and iron; they would then be ready to be placed in their positions below, but the soil should be previously prepared for their reception; for this purpose the earth should be bored from diving bells as deep as the height of the tunnel; it would be necessary to bore closely in a soil composed principally of stone, but in light sandy soils it would be sufficient to bore in the two lines where the edges of the tunnel would rest; the powder being rammed down as usual, a wire should lead from each charge to a battery, so as to blast a large extent of earth at once. This operation might be repeated several times, if there was reason to suppose the earth was not sufficiently loosened, which could be ascertained by descending in diving bells, and driving iron bars into the earth at different places. The blasting being completed, the whole length required to sink the tunnel, the divisons should be let down by filling them with water; then a large quantity of iron should be placed on each division; a few hundred pieces of cannon

would answer the purpose admirably; they might remain on the divisions, or afterwards might be removed, if required for any useful purpose; then the water should be pumped out from each division, and a part of the air removed, to form a partial vacuum; the pressure of air and water, which would be then exerted on the top—would be so tremendous, that they would rapidly sink in the shattered soil; the edges, *b b*, would cut through the earth as if it were composed of tallow or melted pitch; at least the experiments of Dr. Potts would lead us to suppose so.

While this part of the work was proceeding, the tunnel or land should be bored, commencing at a sufficient distance from the shore to have the least possible gradient; it might be arched with brick or stone, or an iron tunnel might be placed inside. The first division of the submarine tunnel being reached, the temporary blockading frame should be removed, and the soil excavated; the earth could be removed with carts placed on the temporary rails of the land tunnel, and drawn by a stationary engine; the excavation would thus proceed much more rapidly than if the earth were raised near the shore as from a well: then the soil having been completely shattered by blasting, could be easily removed from the tunnel, so that each division could be emptied of the earth it contained in a very short space of time, while the work would be attended with no danger whatever. Each division might be sunk to any depth by excavating the soil under the sides; its weight would then cause it to sink to the required depth; care should of course be taken to let it fall gradually and equally, so as to be level with the entrance of the tunnel; the earth being removed, the floor should be fastened to the division, and the next division excavated as before.

It would of course be impossible to sink the tunnel the whole length in the earth; but I would consider this perfectly useless, for in great depths, the water is so dense, that a tunnel would be as firmly fixed below as if it were imbedded in clay: the tunnel might be sunk in the earth one mile or two at each end of the building; the next division should be only partly sunk; the platform or flange outside being constructed at a few feet from the bottom, as in fig. 3, that is, the flange should be constructed at different heights from the bottom, according to the depth which the division would have to be sunk in the soil, so that as deeper water would be reached, the flange would be at the bottom. Fig. 3 represents the tunnel with stones on the

Fig. 3.



outer flanges to prevent its rising by its buoyancy; between the stones placed on the flanges, a large quantity of loose stones might be thrown, over which a cement, which would not be injured by water, might be thrown, so as to form a compact mass. There are various kinds of cement which might answer the purpose, such as the patent English puzzuolano, or metallic sand; this would probably prevent the iron wearing, but it would not be necessary to cover the tunnel the whole length,—at least, not on first constructing it. Then the iron might be galvanized, which would be an additional protection to the metal.

Of course, after being finished, every precautional means would be devised to protect the building, but should it partly wear out in the lapse of time, another tunnel might be placed inside the old one.

In wide channels it would be essential to construct the building as strongly as possible, that many years might elapse before it would require repairs; it would be better to build it with two or even three sets of iron plates, leaving a space of 6 inches between each, which might be filled with some light waterproof substance. Such a tunnel would, even in the deepest channel, be as safe as if it were not surrounded by water. And thus, this building would be as a vast hall in which traffic would be continually carried on, while the raging sea above would be threatening to engulph the vessel floating on its bo-

som, and yet the effect of the storm could not possibly be felt below; for it is easy to comprehend that the agent which puts the sea in motion does not rise from the bosom of the earth, but only from above the water, consequently its effect can only be felt on its surface. Vessels which have foundered in channels, have been found many years after, on the spot where they had sunk, and without being shattered; a submarine tunnel would therefore be as safe below as in any other situation, and would not, probably, wear out so soon as on land, as it would be secure from many casualties to which other buildings are liable.

The expense of constructing submarine railways would, of course, be considerably greater than to construct railroads on land. The quantity of iron required would be about 2 tons per foot; that is, supposing the tunnel to be 26 feet wide and of the same height, the quantity at 10*l.* per ton would cost 103,680*l.* per mile, or 2,073,600*l*, for the material alone of 20 miles. To form it into the shape of a tunnel would cost at least an equal sum; yet, admitting that a submarine railway from Dover to Calais would cost £8,000,000 sterling, it will not, for a moment, be doubted whether the traffic would be sufficiently great to pay the interest on the capital. The value of a railway must not be calculated by its length, but by the amount of traffic which is carried on upon it; thus it is possible that a railway should be made of 200 miles in length, on which the returns would not be so great as on the Dover and Calais Submarine Railway, of 20 miles in length, for the traffic of some thousand miles of railway would be centred in this railway; trains would pour in from all the principal towns of England, and from every city of the Continent. It is probable that trains would be perpetually passing in the tunnel; so that I think it probable, that no other railway would pay so high an interest on the capital. Then it is easy to comprehend that the value of a great many railways on both sides of the channel, would be doubled by the increased traffic which such a facility of communication would bring.

It will be admitted that when two countries are separated by the sea, it is in most respects the same, whether the width of the channel be 20 or 200 miles; it is an almost equally insurmountable barrier to universal communication. Now, if Calais were 200 miles distant from Dover, and that it were possible to construct a submarine railway to connect the two countries, at no greater expense than the cost of many railways on land, £40,000 per mile, or £8,000,000 for 200 miles, the railway would be constructed as soon as the practicability was acknowledged. It would appear evident to every one that no other railway could have such an extensive traffic; but surely the shortness of the line will not be an argument against its construction: it would cost a great deal for its length certainly; but I am confident that no railway on earth of 200 miles in length, would have an equal value. Here, therefore, it would not be quantity but quality; it would be a quart of oil compared to a ton of water.

In rivers it would be a matter of great facility to construct submarine railways; in most cases it would be sufficient to build the tunnel with only one thickness of iron—a sheet of iron of 1 inch thick would answer every purpose; or the iron might be still thinner: but supposing that 1 ton of iron were used per foot, it would be still possible to construct these tunnels and complete them at the rate of £200,000 per mile. If such a tunnel were built in the Mersey between Liverpool and Birkenhead, it would cause the latter town to rise in commerce with great rapidity, and, I believe, that the traffic in the tunnel would be sufficient to pay the interest on the capital; for, in addition to the local traffic, the tunnel would be used as a railway by several companies, to carry their lines of railway, to join the railways now in course of construction in North Wales, which, when completed, will form a direct route to Ireland, from the manufacturing towns of England. The two ends of the tunnel near the sides of the river should be sunk in the earth, as before explained, and, in fact, the whole might be sunk below the bed of the water, although it would be hardly essential to sink it in the middle of the river, as the water is 60 feet deep at low tide. In such a river as the Dee, a tunnel should be sunk entirely in the soil, as the depth of water is not so great, and, of course, when sunk completely below, it would be less liable to wear, or to receive injury by

anchors being thrown suddenly on the arch or other casualties which it might meet with in a river where there is always a great many vessels. There are many other rivers in England in which submarine tunnels would be of considerable use; among these, the Tyne between North and South Shields: the Severn, in which a tunnel would permit the Great Western Railway being extended to Milford in the south west extremity of Wales. Again, in various parts of the Thames, and in the Solent between Hurst Castle and the Isle of Wight, where the sea is only a quarter of a mile wide. The cost of constructing these tunnels would not, I am confident, amount to one-fourth of the cost of boring under the bed of the water, and, at the same time, on this principle, there would be a total absence of danger.

I have hitherto mentioned iron as the material for constructing tunnels, and of course it would be impossible to supersede it by a better material at the same cost. But in countries where wood grows in abundance, such as in the north of Europe and in America, it would be possible to construct tunnels with that material, at a comparatively cheap rate. The wood might be preserved by the well known method of covering it with nails. These tunnels might also be sunk in the earth by fastening an edge of iron at the bottom, or each side, as shown at *b b*, fig. 2, so that they might cut through the shattered soil; in the lapse of time, should the tunnel wear out, an iron tunnel might be placed inside, or even another wooden one instead of iron, provided there were sufficient space inside.

One of the advantages which would result by constructing tunnels in rivers, instead of bridges, would be that the navigation of the river would not be impeded; thus, if instead of the bridges, which are constructed on the Thames, there were submarine tunnels, the river from London Bridge to the west-end of the city, would be navigable for the largest vessels, so that there might be splendid quays on both sides of the river. Then, if the immense cost of building those bridges be considered, we would find another item in favour of submarine tunnels, and I believe one of no trifling importance.

In the preceding description, I have explained the principal details of the work; that, these details may be imperfect, I am aware: I have, however, entered on their description, principally with a view of showing, that if the principle of submarine railways be adopted, no insurmountable obstacle will be found in carrying it out. When the shortest lines of submarine railways shall have been carried out, a vast number of improvements would probably suggest themselves, which would tend to facilitate the universal adoption of the plan, by developing means to construct the tunnels at a cheap rate, and in a very short space of time. When this comes to be the case, we shall see uninterrupted lines of railway of several thousand miles in length; the whole world will become as one vast country; civilization will spread with immense rapidity; and a vast train of evils, inseparable from ignorance, will disappear.

I remain, respectfully,

John De La Haye.

10th Month, 7th, 1845, London Road, Liverpool.

WORKING STEAM EXPANSIVELY IN THE ROYAL NAVY.

Sir,—I have this instant read a letter in your Magazine of the 8th inst., signed "Pressure not Puff," in which the intelligent writer has been pleased to comment upon extracts selected by yourself from two letters written by me to members at the head of my profession; and which were printed, some three or four years since, for their convenience. With a modesty so consistent with talent and a liberal education, your correspondent opens his attack, not upon the supposed offender, but upon the entire members of my profession; and towards the conclusion of his graceful philippic, thus speaks of the board under whom I have the honour to serve:—

"If his friends claim for him the mere reiteration of known principles, upon the dull comprehensions of Lords of the Admiralty, he has undoubtedly merit; although in this Otway certainly took the lead."

Had I been aware that you intended to publish these letters, or even such extracts as would have brought my name before the public, I should certainly, had I had the opportunity, have raised objections; not, however, from the fear of encountering such opponents as your correspondent, but because the ground

has already been sufficiently traversed: and, moreover, you have omitted paragraphs which ought certainly to have appeared.

In paragraph the second he writes, after a sneer at the members of my profession, "Still it is going rather too far to allow them to appropriate to themselves, as their individual *inventions*, the most common laws and fundamental rules of civil engineering, as applied to marine purposes." In the name of common sense, who ever heard of an individual being able to appropriate to himself as an invention the common laws and fundamental rules of civil engineering? The writer has evidently not ability sufficient to put upon paper what he means; and consequently the onerous task of finding words to explain his ideas devolves upon me. He meant to say, no doubt, "Still it is going rather too far to allow them to appropriate to themselves, as original *discoveries*, the common laws and fundamental rules of civil engineering." It would have certainly have been going too far had I (as one of the parties alluded to) done so; but in one short letter to Sir William Parker, I twice write thus:—"I beg to disclaim any originality in the conception, as in the course of this letter I shall clearly show."—"Again disclaiming all originality of conception, and only trusting through you my remarks may be beneficial to the service, I have the honour to be, &c., &c,"

In paragraph the fourth he misquotes what I have written, and only succeeds in making the paragraph ridiculous by making it his own.

Dr. Lardner, in his sixth edition—a work in tolerably extensive circulation—undertook to prove that the resistance of the water decreased with the increase of speed, and denied the generally received law,—that the resistance to a vessel passing through the water was as the squares of the velocities. I undertook to prove by an appeal to facts more conclusive than those cited by Dr. Lardner, that the converse of what he stated was the truth; and contented myself with showing that the resistance of the water increased in even a greater ratio than that of the squares.—But I left entirely untouched the question as to what horse-power ought to be placed in a vessel in consequence of this increased resistance of the water, as it was not, from the line of argument I had adopted, the subject under discussion. These are entirely separate questions, and are very clearly proved to be such in Lieut. Gordon's work, entitled, the "Economy of the Marine Steam Engine;" see page 83.

In paragraph sixth your correspondent is found blundering again, although he would lead you to infer that he is a civil engineer; for, instead of the Phœnix having a collective horse power (at the time referred to) of only, as he states, 110 horses' power, her power was just double, namely, 220 horses. Had he been even tolerably conversant with his profession, he would have doubted whether a horse-power such as he states it was, namely, but one-eighth of her tonnage, could possibly have imparted to the Phœnix a mean average velocity of nine knots per hour; but being evidently a mere theorist, he could not possibly fall back upon my experience to correct his error.

I agree with your correspondent, that "the required horse-power is as the cubes of the velocities," although that able writer, Mr. John Scott Russel, contends for its being as the squares. Had I fallen into the error which I believe Mr. Russel has, (see his work,) I should certainly have had a most talented individual to keep me company; and thus your able correspondent will perceive that fundamental laws are sometimes called in question by some of the ablest men of the day. Only think of "Pressure not Puff" being at issue with the writer of the article upon Steam in the last edition of the Encyclopedia Britannica!

In paragraph the seventh, your amusing correspondent (who I will engage will never have the courage to attach his name to any letter in reply to me, from the fear of the diversion it will afford to the members of his profession at his expense,) states, "Mr. Hoseason writes as if the theory of expansion was a new thing—in fact, that he had almost (-covered its practical application." O y think of his writing this, when any p -son who may have perused the extr s you have given from my letters will e able to perceive the absurdity of such n assertion! I distinctly stated that si - one years had elapsed since the disco y of the expansive action of steam, eve it the time of my writing, which is r years since.

I shall pass over his observations with respect to Captain Otway and myself, with this slight remark, that Captain Otway deemed it essential to raise steam to a pressure of at least two atmospheres, and with it a change of shape of the boilers; and thus he swam against the stream of prejudice. Not calling in question the correctness of Captain Otway's views, I advocated working steam expansively, with a high power in proportion to the tonnage; content to obtain as much good as I could, without encountering the same prejudices.

I see the Government engineers have come in for a slight poke, in the last paragraph but one. However, I have no question but they will be able to tell him that some very beautiful results have been obtained with the expansive gear, from pressures not exceeding 5 lbs. on the valve; and consequently there was no excuse for those who supplied engines unfitted with the necessary gear, merely because a higher, and therefore a more advantageous pressure, was deemed objectionable at the period such engines were constructed.

No individual entertains a higher opinion of the civil engineers of the country than the writer of this letter, as none but a charlatan would deem all others blockheads but the members of his own profession. Were I to try your ingenious correspondent by such a standard, what a precious figure he would cut.!

With many thanks for the space allotted me, believe me,

Your obedient servant,
J. C. Hoseason,
Commander R.N.

Army and Navy Club, November 10, 1845.

A NEW AND EXPEDITIOUS METHOD OF FINDING THE ROOTS OF THE HIGHER EQUATIONS, ETC. BY THE METHOD OF LIMITING DIVISORS.

Sir,—Soon after having finished my last table for finding the roots of cubic equations, I discovered that numerical equations of all orders, from a quadratic upwards, may be most expeditiously solved, and the root, or roots, found to any required degree of accuracy, by the aid of the limiting divisors. For, from what has been already explained on this subject, the following solutions of equations of the 3rd, 4th, and 5th order will be easily understood.

Example 1*st. Given* $x^3-9x=10$ *to determine the three roots of the equation.*

It is perceived at once that x is between 3 and 4. Let $x=3+z=n+z$, and let $9=P$, $10=a$;

$$\therefore \left.\begin{array}{l} x^3=n^3+3n^2z+3nz^2+z^3 \\ -Px=-Pn-Pz \end{array}\right\}=a.$$

$$\therefore z=\frac{a-n(n^2-P)}{3n^2-Pn+(3n+z)z}\text{; and here}$$

z must be a fraction, its limits being between 0 and 1. Hence,

a	=		10
$-n(n^2-P)$	=		0
			—
$3n^2-P$	=	18. L.L.D.	10
$(3n+z)z$	=	10	—
		—	
		28 G.L.D.*	

That is, the true divisor for finding the value of z is between 18 and 28. Now, 10 divided by 18 quotes a little more than ·5, and by 28 a little less than ·4. Let $x=3{\cdot}4+z=n+z$, then the limits of z will be between 0 and ·1. Hence,

a	=		10
$n(n^2-P)$	=		8 704
			——
$3n^2-P$	=	25·68 L.L.D.	1·296
			——
$(3n+z)z$	=	1·03	
		——	
		26·71 G.L.D.	

And 1·296 divided by either of the limiting divisors, will quote ·04. Hence, $x=3{\cdot}44+z=n+z$,

a	=	10
$n(n^2-P)$	=	9·747584
		——
		0·252416

and z is between 0 and ·01

$3n^2-P$	=	26·5008 L.L.D.
$(3n+z)z$	=	1033
		——
		26·6041 G.L.D.
		——

and 1·294 divided by either of the limiting divisors will quote ·009;

* L.L.D. and G.L.D. are contractions for lesser and greater limiting divisors.

$$\begin{array}{lrr}
\text{hence, } \cdot01 : \cdot1033 : : \cdot009 & : & \cdot09297 \\
& \text{L.L.D} & 26\cdot50080 \\
\hline
\text{1st approximate divisor} & & 26\cdot59377
\end{array}$$

$$\begin{array}{lrr}
\text{and } \cdot252416 \div 26\cdot594 = & \cdot009489 & \\
\text{as } \cdot01 : 1033 : : \cdot009489 & : & 09802137 \\
& \text{L.L.D.} & 26\cdot50080000 \\
\hline
\text{2nd approximate divisor} & & 26\cdot59882137
\end{array}$$

Hence, $\cdot252416 \div 26\cdot59882137 = \cdot009489743$, and $x = 3\cdot449489743$, and this value of x computed by the assistance of the limiting divisors is true to 9 figures, and the 10th only differing by 1. For x has two negative roots, one of which is—2; hence $x^3 - 9x - 10 \div x + 2 = x^2 - 2x - 5 = 0$; and solving this quadratic, we find $x = 1 \pm \sqrt{6} = 3\cdot4494897427$, or $-1\cdot4494897427$. The given equation was so formed, that one of its roots should be -2, so that we might the more easily verify the accuracy of the solution; had we assumed $n = 3\cdot449$ as the last basis of solution, we might have obtained the value of x true to 13 places, so that every step that is made will at last treble the number of figures, and any expert and accurate calculator may find the root true to 9 or 10 figures in as many minutes.

It is not necessary to take away the 2nd term of the equation.

Example 2nd. *Given* $x^3 + 10\, x^2 + 12\, x = 48$, or $x^3 + P\, x^2 + r\, x = a$. Let $x = n$ nearly, and $x = n + z$; then, as in the first Example $z = \dfrac{a - n(n^2 + Pn + r)}{3n^2 + 2\,P\,n + r + (3\,n + P + z)z}$, x is found to be between 1 and 2. Let $x = 1 + z = n + z$,

$$\begin{array}{lrrr}
a & = & & 48 \\
n(n^2 + P\,n + r) = & & & 22 \\
\hline
3n^2 + 2\,Pn + r & = & 35 \ . \ \text{L.L.D.} & 26 \\
(3\,n + P + z)z & = & 14 & \\
\hline
& & 49 \ . \ \text{G.L.D.} &
\end{array}$$

and $26 \div 43 = \cdot5$; $\therefore\ n = 1\cdot5$. Let $n = 1\cdot5 + z = n + z$. Then,

$$\begin{array}{lrr}
a = & & 48 \\
n(n^2 + Pn + r) = & & 43\cdot875 \\
3\,n^2 + 2Pn + r = & 48\cdot75 \ \text{L.L.D.} & 4\cdot125 \\
(3n + P + z)z = & 1\cdot46 & \\
& 50\cdot21 \ \text{G.L.D.} &
\end{array}$$

and $4\cdot125 \div 49 = \cdot08$; $\therefore\ n = 1\cdot58$ and $x = 1\cdot58 + z = n + z$. Hence,

$$\begin{array}{lr}
a = & 48 \\
n(n^2 + Pn + r) & 47\cdot868312 \\
\hline
3n^2 + 2Pn + r = 51\cdot0892 \ \text{L.L.D.} & 0\cdot131688 \\
\hline
(3n + P + z)z = \ \cdot1475 & \\
\hline
51\cdot2367 \ \text{G.L.D.}; &
\end{array}$$

and $\cdot131688 \div 51\cdot162$ ($\frac{1}{2}$ the sum of the limiting divisor) $= \cdot002574$. Hence,

$$\begin{array}{lr}
\cdot01 : \cdot1474 \ : : \ \cdot002574 : & \cdot0379665 \\
\text{Lesser L. divisor} & 51\cdot0892 \\
\hline
\end{array}$$

Approximate divisor $51\cdot1271665$, and $\cdot131688 \div 51\cdot1271665 = \cdot0025756947$. Hence, $x = 1\cdot5825756947$, and this value of x is true to 10 places of figures. For x has a negative value, which is—4. Hence, $x^3 + 10x + 12x - 48 \div x + 4 = x^2 + 6x - 12 = 0$, and solving this quadratic we find $x = \pm\sqrt{21} - 3 = 1\cdot5825756949$, or $-7\cdot5825756949$.

One or two more examples will be given of equations of the 4th and 5th order, &c., and the subject concluded in a future communication.

GEORGE SCOTT,
Private teacher of the Mathematics.

16, Wyndham-street, Bryanston-square,
November 1, 1845.

LIGHT AND ELECTRICITY.—MR. FARADAY'S GREAT DISCOVERY—FURTHER PARTICULARS.

Mr. Faraday's discovery is, that a beam of polarized light is deflected by the electric current, so that it may be made to rotate between the poles of a magnet; and, as we understand, the converse of this, that electro-magnetic rotations may be produced

agency of light. Thus the problem which has disturbed science for a long period as to the power of magnetizing iron by the sun's rays, as stated by Mrs. Somerville, Morrichini and others, receives satisfactory elucidation from the indefatigable industry of Mr. Faraday. Already has he proved the identity of machine, chemical, magnetic and animal electricity; and now, advancing a step higher in the inquiry, he finds the most ethereal principle with which we are acquainted capable of producing phenomena which have hitherto been regarded as the exclusive property of ponderable bodies only. Light, the subtile agent of vision, the source of all the beauty of colour, is now shown to have some close relation with electricity, to which has long been referred many of the vital functions. As life and organization exist only where there is light, this discovery of Mr. Faraday would appear to advance us towards some knowledge of those physiological phenomena which are the most recondite subjects of science.—*Athenæum*.

ON THE COMPOSITION OF FIRE-DAMP AND PREVENTION OF COAL MINE EXPLOSIONS. BY PROFESSOR GRAHAM.

[Abstract of a Paper read before the Chemical Society, November 3.]

Some years ago Professor Graham examined the gas of the Newcastle coal mines, with the same result as Davy, namely, that it contains no other combustible ingredient than light carburetted hydrogen. But the analysis of the gas of the coal-mines in Germany, subsequently published, showing the presence of other gases, particularly of olefiant gas, rendered a new examination of the gas of the English mines desirable. The gases were, (1) from a seam named the Five-Quarter seam, in the Gateshead Colliery, where the gas is collected as it issues, and used for lighting the mine; (2) the gas of Hepburn Colliery, which issues from a bore let down into the Bensham seam—a seam of coal which is highly charged with gas, and has been the cause of many accidents; and (3) gas from Killingworth Colliery, in the neighbourhood of Jarrow, where the last great explosion occurred. This last gas issues from a fissure in a stratum of sandstone, and has been kept uninterruptedly burning, as the means of lighting the horse-road in the mine, for upwards of ten years, without any sensible diminution in its quantity. The gases were collected personally by Mr. J. Hutchinson, with every requisite precaution to insure their purity, and prevent admixture of atmospheric air. The usual eudiometrical process of firing the gases with oxygen was sufficient to prove that they all consisted of light carburetted hydrogen, with the exception of a small per centage. It was observed that phosphorus remains strongly luminous in these gases, mixed with a little air; while the addition of one four-hundredth part of olefiant gas, or even a smaller proportion of the volatile hydro-carbon vapours, destroyed this property. Olefiant gas itself, and all the allied hydro-carbons, were thus excluded. Another property of pure light carburetted hydrogen, observed by Mr. Graham, enabled him to exclude other combustible gases, namely, that the former gas is capable of entirely resisting the oxidating action of platinum black, and yet permits other gases to be oxidated which are mixed with it even in the smallest proportion, such as carbonic oxide and hydrogen, the first slowly, and the last very rapidly; air, or oxygen gas, being, of course, also present in the mixture. Now platinum black had not the smallest action on a mixture of the gas from the mines with air. The gas was also inodorous, and clearly contained no appreciable quantity of any other combustible gas than light carburetted hydrogen. The only additional matters present were nitrogen or oxygen, or air; the specimen collected in the most favourable circumstances for the exclusion of atmospheric air, namely, that from the Bensham seam, still containing 0·6 per cent. of oxygen. The gases also contained no carbonic acid. Attention was directed to the result that nothing oxidable at the temperature of the air was found in a volatile state associated with the perfect coal of the Newcastle beds. The remarkable absence of oxidability in light carburetted hydrogen appears to have preserved that alone of all the combustible gases originally evolved in the formation of coal, and which are still found accompanying the imperfect lignite coal of Germany, of which the gas has been examined. This fact is of geological interest, as it proves that almost indefinitely protracted oxidating action of the air must be taken into account in the formation of coal; air finding a gradual access through the thickest beds of super-imposed strata, whether these strata be in a dry state or humid. In regard to measures for preventing the explosion of gas in coal-mines, and of mitigating the effects of such accidents, Mr. Graham confined himself to two suggestions. The first has reference to the length of time which the fire-damp, from its lightness, continues near the roof, without mixing uniformly with the air circulating through the workings. He found that a glass jar, of six inches in length and one inch in

diameter, filled with fire-damp and left open with its mouth downwards, continued to retain an explosive mixture for twenty minutes. Now it is very desirable that the fire-damp should be mixed as soon as possible with the whole circulating stream of air, as beyond a certain degree of dilution it ceases to be explosive. Mr. Buddle has stated, "that immediately to the leeward of a blower, though for a considerable way the current may be highly explosive, it often happens that after it has travelled a greater distance in the air-course, it becomes perfectly blended and mixed with the air, so that we can go in to it with candles; hence, before we had the use of the Davy lamp, we intentionally made 'long runs,' for the purpose of mixing the air." It was recommended that means be taken to promote an early intermixture of the fire-damp and air; the smallest force is sufficient for this purpose: as a downward velocity of a few inches in the second will bring the light gas from the roof to the floor. The circulating stream might be agitated most easily by a light portable wheel, with vanes, turned by a boy, and so placed as to impel the air in the direction of the ventilation, and not to impede the draft. The gas at the roof undoubtedly often acts as an explosive train, conveying the combustion to a great distance through the mine, while its continuity would be broken by such mixing, and an explosion, when it occurred, be confined within narrower limits. Secondly, no effective means exist for succouring the miners after the occurrence of an explosion, although a large proportion of the deaths is not occasioned by fire, or injuries from the force of the explosion, but from suffocation by the after-damp, or carbonic acid gas, which afterwards diffuses itself through all parts of the mine. It was suggested that a cast-iron pipe, from eight to twelve inches in diameter, be permanently fixed in every shaft, with blowing apparatus above, by which air could be thrown down, and the shaft itself immediately ventilated after the occurrence of an explosion. It is also desirable that, by means of fixed or flexible tubes, this auxiliary circulation should be further extended, and carried as far as practicable into the workings.

LAWS OF FALLING BODIES.

Sir,—In vol. xxxiv, page 292, there is a communication of mine relative to laws of falling bodies, and in page 347 there is a reply to the same, by Mr. M'Iver, the object of which is to show that the arguments which I have advanced against the Newtonian doctrine are nothing but absurd deductions from it.

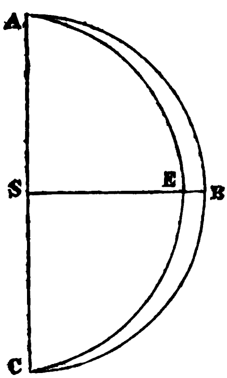
Now, Sir, having since the time I made that communication been able to procure proper information on the subject, I think that I can now clearly demonstrate what I then advanced, and therefore I think that in justice I am entitled to a reply.

In that communication I showed that a body falling from the moon would arrive at the earth's surface in $8,794^m$, or more accurately, in $8,791{\cdot}808^m$, with a final velocity of 281,337,851 feet per minute; and also that a body would fall ten times higher than the moon to the earth's surface in $278,003^m$, with a final velocity of 88,961 feet per minute, the time of descent varying directly as the square root of the cube of the distance, the velocity inversely as the square root of the distance, and the times of descent directly as the cube of the velocity, which are the very same laws which are found to obtain in the planetary system. The objection against the Newtonian theory is that the results here exhibited do not agree with the phenomena seen around us. But Mr. M'Iver says that these results are not in accordance with the Newtonian doctrine, and it remains for me to show that they are.

It is plainly taught in the Newtonian doctrine that the sagittæ of the arcs which the moon describes in a given time, are the measures of the centripetal force, or the space through which the moon would descend towards the earth in that time, were it not restrained by its projectile force; also, that from the enlargement of the arc the sagitta is augmented in the duplicate ratio thereof. And since the arc is the measure of the time, the sagitta, or the approach towards the earth, will be as the square of the times. Furthermore, if the sagittæ of the arc which the moon describes in a given time, be compared with the sagittæ of the arc which another body revolving round the earth would describe in the same time, they will be found to vary inversely as the square of the distance, by which comparison Newton demonstrated the truth of his theory. Seeing this to be the case, we are at liberty to institute a comparison between the sagittæ of two arcs described in the same time, without any regard to their size; for the same proportion will hold true whether we institute a comparison between arcs in their nascent state, or one-fourth of their orbit. Thus, we may take the distance of the moon from the earth's surface and compare it with the sagittæ of the arc which a body would describe at ten times the moon's distance in the time given above for the moon to fall to the earth, and the moon's distance will be found to be 100 times greater than the sagitta thereof, which gives just the same

results as if we took the arcs which the two bodies would describe in any less portion of time. And therefore they who deny that two bodies, the one falling from the moon, and the other ten times higher, will not take the time, and acquire the velocity here given, must also deny that the one will not gravitate towards the earth 16 feet in a minute, and the other 16 feet, and by so doing they will take away at once the foundation of the Newtonian doctrine. This reasoning is strictly mathematical, and is in accordance with the doctrine of the composition of forces, for were the moon unrestrained by its projectile force, it would fall to the centre of the earth in the same time as it describes one fourth of its orbit.

But it remains for me now to examine into the derivation of the formulæ advanced by Mr. M'Iver, which I think may be best investigated as follows. Suppose two bodies,



e to revolve in the circumference of the semicircle, A B C, and the other in the semiellipse, A E C, then, by the law of the equable description of areas, the time of describing the semicircle will be to the time of describing the semiellipse, as the area of the one to the area of the other. If we now suppose the ellipse to be continually diminished in breadth, it is evident that as its area becomes less, its time of description will become less in the same proportion. Suppose it now to continue to decrease in breadth until it coincide with the right line, AC, then it is evident from the same mode of arguing that the time of descent down A C, will be to the time of describing the semicircle as A B C to A C, or the time down A S to the time of describing A B, as A S, A B. So that if we suppose the semicircle A B C, to be half of the moon's orbit, and S the centre of the earth, the time of descent down A S, will be to the time of describing one-fourth of the orbit, as A S, A B; and the same things will obtain if we suppose the semicircle to be the orbit of a body revolving round the earth at ten times the moon's distance. Now A B and S A always being to each other in the same invariable ratio, the times of descent of the moon to the earth, or of the planets to the sun, may be very easily determined. This ratio is termed by astronomers, the sesquiplicate ratio, and in most elementary works on astronomy there is given a rule to determine the times of descent of the planetary bodies, which is to divide their periodic times of revolution by 5,656. And as by Kepler's third law the period varies directly as the square root of the cube of their distances, and the times of descent being the times of revolution divided by the same constant quantity, the times of descent will vary in the same proportion of the distances as the times of revolution do. And this is what I demonstrated in my former communication.

Now Mr. M'Iver calculated the time of descent from the moon to be $417{,}157^m$, or $6952\cdot6^m$, which is in the sesquiplicate ratio, and proceeding on the arguments above advanced, to find the time of descent of a body falling ten times higher than the moon, we shall have $\sqrt{^3 10} \times 6952\cdot6^m = 219860\cdot4^m$, for the time of descent. Then by mechanics, a body descending from any height will go over the same space in half the time with the velocity acquired at the end of the fall, consequently it will go over the same space in the same time with half that velocity; therefore we have

$$2 \times \frac{1236734400}{6952\cdot6^m} = 355848 \text{ feet, and}$$

$$2 \times \frac{12367344000}{219860\cdot4} = 112501\cdot8 \text{ feet per minute}$$

for the final velocities of the two bodies respectively. And, again

$$\sqrt{\frac{12367344000}{1236734400}} = 3\cdot16 \text{ and } \frac{355848}{112501\cdot8} = 3\cdot16$$

that is, the final velocities vary inversely as the square root of the distances, according to my former demonstrations. Now Mr. M'Iver calculated the velocity of a body falling from the moon to be 36,411 feet per second, or 2,184,660 feet per minute, and that of a body falling ten times higher, would be a trifle greater, consequently the times of descent, according to this velocity, would be from the moon $4^h\ 43^m$, and ten times higher, rather less than two days. So much for the agreement of Mr. M'Iver's formulæ for calculating the times of descent and the velocities required.

Thus it appears that the time of descent from the moon, and the velocity acquired, as deduced from the time and space gone

over, given by Mr. M'Iver, only differs from my calculated time and velocity in quantity, and not in proportion. The same may be said of the time and velocity of the descent ten times higher than the moon, for that time and velocity acquired are deductions made strictly in accordance with the Newtonian doctrine, and also with Newton's definition of the sesquiplicate ratio. "*Rationem vero sesquiplicatem voco triplicatur subduplicatum quæ nempe ex simplici et subduplicato componitur.*"

It now remains for me to show that the method pursued by Newton, in determining the times of descent and the velocity acquired or given, lib. i. sec. 7, "Principia," is not in accordance with his "Art of Orbit Building."

According to that theory, if a body be projected with a certain velocity, it will revolve in a circle; if the projected velocity be a little greater, it will revolve in an ellipse, &c.; but the dimensions of the ellipse will be greater than the circle.

From the same arguments it follows, that if a body be projected with a less velocity than that which would cause it to revolve in a circle, it will also describe an ellipse, but which will be of less dimension than the circle. And this is in accordance with Cor., prop. 15, lib. i. "Principia," which says, "Therefore the periodic time in an ellipse is the same as in a circle whose major axis is equal to the diameter of the circle."

Suppose, then, two bodies to revolve, one in the circumference of the semicircle ABC, and the other in the ellipse AEC, the lines of description will be equal by the above-mentioned corollary, and so of any two corresponding parts, as AB and AE. And proceeding according to Newton's method, suppose the ellipse to be continually diminished in breadth, then it is evident, if the times of description must continue equal, that the velocity in the ellipse must be diminished in the same ratio at its breadth. Suppose the ellipse to be diminished until it coincide with the right line A, then the line of descent down AC will equal the time of describing ABC, or the descent down AS is equal to the time of describing AB. So long as the ellipse remains a curve it is understood to be composed of the projectile and centripetal forces; but when it changes into the right line AC, it is evident that the projectile force must have vanished, and the body by hypothesis descends down the sole right line simply by the force of gravity. Thus it appears that the projectile force increases the velocity, so that a body will describe one fourth of its orbit in the same time as it would descend to the centre of the body round which it moved simply by the force of gravity, provided that body be placed in the centre of the orbit; and this will be so without respect to the form of the orbit; that is, according to the above-mentioned corollary. I am, sir,

Yours respectfully,

W. DAVISON.

Stockport, Sept. 24, 1845.

NOTES AND NOTICES.

Native Copper.—A letter from Lake Superior states that native copper in large masses, continues to be found. A piece lately discovered near the lake-shore, by Major Campbell, weighs about 16 hundred, is purer than the copper of commerce, and is altogether the most beautiful specimen ever seen.

Prevention of Boiler Incrustations.—On board the *Echo* steam vessel, in this (Portsmouth) harbour, an experiment is being tried of Dr. Ritterbandt's patent method of preventing incrustation in steam boilers. The substance employed is chloride of ammonium, a harmless salt. One of the greatest difficulties with which engineers have to contend in the application of steam is the incrustation of the boiler, producing not only a great expenditure of fuel, but often fatal explosions, especially in tubular boilers, as their peculiar form almost entirely prevents scaling or the application of other mechanical remedies. The experiment has been eminently successful in its application to the boilers of the *Echo*, under the superintendence of the patentee and Mr. Taplin, of this dockyard. The substance does not discolour the water, nor communicate to it any unpleasant taste or smell; it has no injurious effect upon the metal of the boiler; does not increase the density of the water, therefore does not produce "priming;" nor does its application involve any alteration in the boilers now in general use. The action of the chloride of ammonium is to change the carbonate of lime into chloride of calcium, which is not deposited by heat; and as the crystallization of other salts, such as the sulphate of lime, depends in a great measure upon contact, the absence of nuclei of solid carbonate prevents, in a great measure, their formation. In marine boilers this is very evident, for after adding chloride of ammonium, and thus preventing the precipitation of insoluble carbonate of lime, it is almost impossible to obtain crystals of common salt, thus "blowing off" is rendered almost unnecessary, in proof of which the *George IV.* commercial steamer, plying between this port and Southampton, worked 12 days without blowing out, merely by using a small quantity of the material every day, nor when the boiler was afterwards examined was there any exhibition of a tendency to deposit.—*Times Correspondent.*—For a full description of Dr. Ritterbandt's process, see *Mech. Mag.*, *vol.* xlii. p. 429.

Mineral Wealth of the United States.—At a recent meeting of American geologists, Prof. Shepherd expressed his opinion, that both diamonds and platina would be found in abundance in the gold region of Connecticut, also in South Carolina and Georgia. This opinion he predicates upon the fact, that elastic sandstone has been discovered in some of the western counties of that state, Burk and Buncombe, and other states; and, where this is found, it is a geological indication of the presence of the diamonds or platina. In Hall county, Galena, a perfect diamond was found in one of the gold washing deposits, and one other was, unfortunately, broken in pieces by the workmen.

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

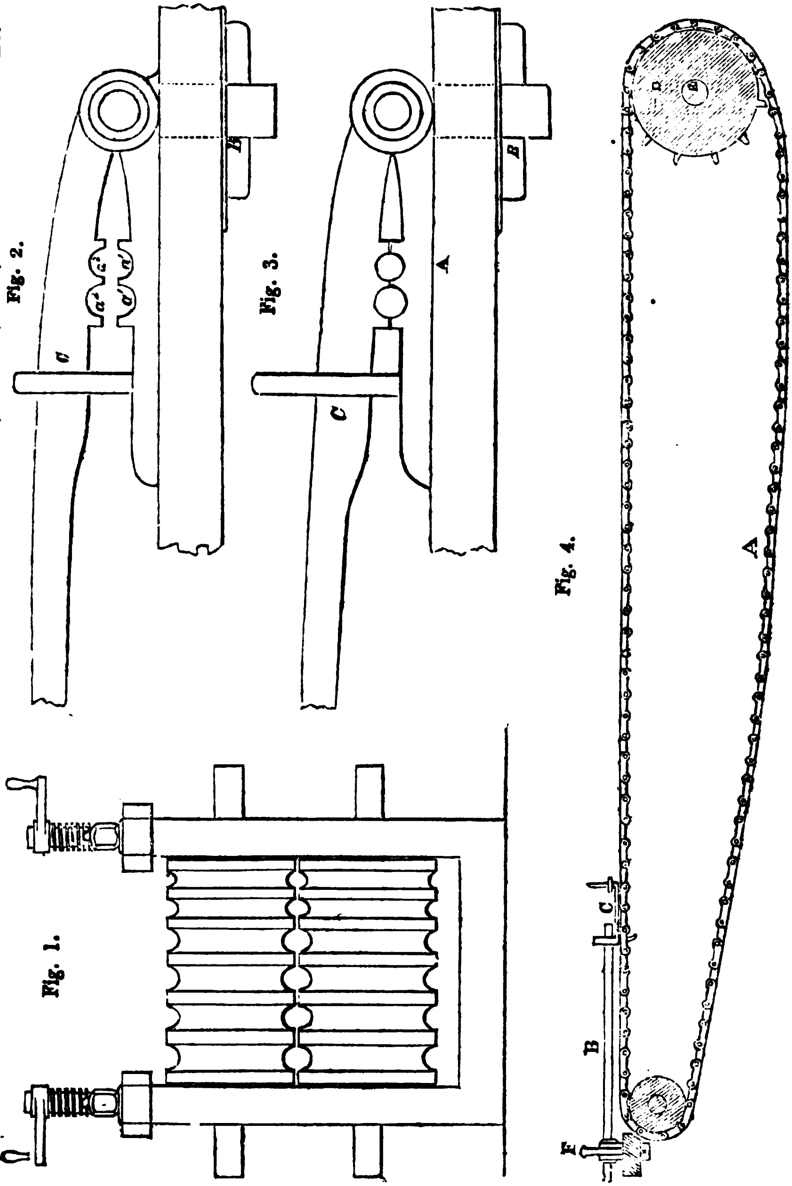
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1163.] SATURDAY, NOVEMBER 22, 1845. [Price 3*d*.

Edited by J. C. Robertson, No. 166, Fleet-street.

SOTHER'S PATENT IMPROVEMENTS IN LOCOMOTIVE, MARINE, STEAM, GAS, AND OTHER TUBES.



ROYLE'S PATENT IMPROVEMENTS IN LOCOMOTIVE, MARINE, STEAM, GAS, AND OTHER TUBES.

[Patent dated April 15; Specification enrolled October 15, 1845.]

The specification of Mr. Royle recites that "by one mode of manufacturing locomotive, marine, steam, gas, and other tubes which is now in use, and well known,* the piece of iron commonly called a skelp, out of which the tube is made, is first heated to a welding state throughout one half of its length, and then drawn through pincers by an endless chain, in order to weld the edges together, and round and smooth the outer surface of the tube, after which the other half is heated in the same manner, by which mode of operation a considerable waste of time and labour is caused, and perfect uniformity in the tube is rendered difficult of attainment;" and that by "another mode of manufacturing such tubes which is in use,† the whole of the skelp is heated at once, and welded by passing it between four grooved rollers, the groove of each roller forming one quarter of a circle, and the four grooves forming by their union an entire circle, which gives to the welded skelp its proper circular form;" but that "this process is also objectionable on account of part of the iron of the skelp being pressed out between the rollers and remaining on the outside in the form of ribs, which must be afterwards removed at great trouble and expense, by chissel, file, or grindstone."

Mr. Royle proposes to remedy the defects of both these methods by "heating the whole of the skelp from end to end at once, and converting it into a perfect tube by welding, rounding, smoothing, and finishing *before allowing the metal to cool;* whereby he accomplishes what requires by the mode first before described two distinct heating processes, and he avoids altogether the chipping, filing, or grinding, attending the second mode."

The following description of the manner in which he effects this important improvement we give in the words of the specification.

"First, an air furnace is built of sufficient length to contain the entire skelp, or tube. The skelp is then bent by the ordinary bending machinery, so that the edges either touch or lap over each other according to the strength of the tube required. The skelp so bent is next placed in the air furnace and allowed to remain there until it is heated to a welding heat. It is then taken out and passed through a pair of rollers, grooved so as to form a series of six circles at the point of union, as shown in fig. 1 of the drawings hereunto annexed, the grooves of each pair being less than those of the pair immediately preceding it (reckoning from right to left.) If the tube is not sufficiently welded at the first drawing, it is returned to the air furnace, having been necessarily somewhat cooled in passing through the rollers, and when it is again up to the welding heat, the process of passing through the rollers is repeated, and so for a third time if it should be necessary. The tube may either have a mandril inserted or not. After the tube has been passed through the rollers the last time it is drawn through a moveable scraper, of the clamp-like construction represented in figs. 2 and 3, fig. 2 representing it open, and fig. 3 representing it closed. A is the stock of this scraper, and B a cotter for holding it down; C is the working beam, which turns on a hinge attached to one end of the stock; a^1 a^1 are grooves cut out of the upper face of the stock, and a^2 a^2 corresponding grooves cut out of the under face of the beam, so that on the two sets of grooves being brought together they form two circular holes for the tubes to pass through, one being of larger diameter than the other. The tube is first drawn through the larger hole, and then through the smaller, and by the two operations is effectually scraped and smoothed.

"The method by which the tube is drawn through the scraper is by gripping it in an instrument, called in the trade, a draught or pincers, which holds the end of the tube fast; the instrument, so holding the tube, is then fixed to the link of an endless chain by a bolt, and this chain revolves round a spiked roller driven by a steam engine or other power at the one side, and by a plain roller at the other. The chain in its passage draws the pipe through the scraper, and when the draught, or pincers, reaches the turn of the chain, the bolt is drawn and the draught released from the chain. The chain and draught are represented in fig. 4. A is the endless chain; B, the tube to be scraped; C, the draught or pincers; D, the spiked wheel; E, the spindle, connected with the steam engine or other moving power; F, the scraper. When, as it sometimes happens, the quality of the iron is such that it is liable to blister. A solid die, with a round hole in it, may be used instead of the moveable scraper."

* Russell's process.—ED. M. M.
† Prosser's.—ED. M. M.

It has been quoted often,
With a full meed of credit,
The maxims wise Wotherspoon taught in his day,
"Never to speak till you've something to say,
And *to stop when you have said it.*"

Sir,—The "Notes of a Fireman" prepared by five months' laborious incubation, after being recalled, remodelled, and amended, have at last been abruptly concluded by a withdrawal and adjournment *sine die*—under circumstances which leave little probability of their ever being resumed. I now beg leave therefore, on the principle of "rubbing off as we go," to reply to the "Notes" already before your readers, and furnish such explanations as are necessary to establish the position I have hitherto maintained in your pages; and while I regret the necessity for recapitulating matters of but partial interest, be assured I will endeavour to dispose of the points at issue as briefly as I well can.

At the outset, I feel it due to all parties to state that, the signature of my opponent is a *nom de guerre* assumed for the occasion; that the writer, so far from being "a Fireman" (*i. e.* one of Mr. Braidwood's men,) is a perfectly free agent in this matter; and that, if the relation of *master* and *man* really exists, it is not in the direction implied by the signature of "A Fireman."

"A Fireman" then, no matter what colour, whether white, black, or brown, has undertaken the praiseworthy (?) object, of converting the review of a scientific paper, into a personal attack upon Mr. Braidwood and his gallant corps. This has been partly accomplished by mixing up matters having no real connexion with each other, by unwarrantably colouring some facts and misrepresenting others; by taking short sentences, and even parts of stentences from detached papers, placing them in juxtaposition, and thereby eliciting a different meaning from that which, when the context is considered, they were intended to convey; by interpolating quotations, and by the free use of such scurrilous terms and paltry prevariations, as are never resorted to but by desperate men writing in a bad cause.

In explanation then, I beg to observe, that *no change* has taken place in my opinion with regard to the "London Fire-brigade or its respected Chief." As the paid servant of a trading association, Mr. Braidwood's general conduct is not a legitimate subject for public criticism; it may, however, be matter of commendation, and his well-deserved meed of praise I have ever been, and still continue most anxious to award him. From my first mention of Mr. Braidwood, when I "congratulated the Directors of the Establishment on their good fortune in securing his valuable assistance,"* to the opening of my last paper which has raised the pseudo "Fireman's" ire, where I stated that "Mr. Braidwood is a gentleman who has for some years discharged the arduous and onerous duties of a semi-public office with satisfaction to his employers and credit to himself:" to these, as well as to the numerous commendatory notices which have appeared between, I now say Amen—nor would I wish to retract or qualify a single laudatory remark.

With Mr. Braidwood, *the author*, however, the position is widely different; his published writings, like those of others, are legitimate subjects of review; and if, on comparison with facts, or with the recorded opinions of others, a difference is found to exist, it lies open to the freest investigation. Mr. Braidwood's statements and opinions will be tested with those of existing authorities, and approved or condemned in proportion as they agree with, or differ from the accepted standard. If Mr. Braidwood's papers are carefully compiled, or truthfully written—if his hypotheses are rational, and his conclusions just, his writings will add to his celebrity. But, on the other hand, if hastily and carelessly compiled, his hypotheses unsupported, and his reasoning incorrect, no *official merit* can avert the condemnation that will pass on his productions.

In order to give the desired "evil tone" to a "Fireman's notes," my strictures on Mr. Braidwood's "Paper" have been hashed up with my last Annual Report of London Fires, so as to give a personal and offensive character to each, not really belonging to either. I will not allow myself to be led away by so bad an example, but confine my remarks on this occasion, to the vindication of my *Annual Report of London Fires*, de-

* Vide *Mech. Mag.* vol. xviii. page 269.

ferring to future papers a full and entire justification of my strictures on Mr. Braidwood's Pamphlet.

In my last Annual Report of London Fires, I had occasion to refer to the very limited usefulness of local experience, and illustrated my position by referring to Mr. Braidwood's experience in *Edinburgh*, where he found engines with *six*-inch barrels best adapted to the *police* requirements of that metropolis; while for *Fire-office* purposes in *London* he eventually found engines with *seven*-inch barrels most advantageous.* "A Fireman" insinuates that my statement is untrue, by stating that "there were no engines with six-inch barrels used in the northern metropolis, while Mr. Braidwood was there!" True, but the disingenuousness and evasiveness of a "Fireman" will be made apparent by the following extract from Mr. Braidwood's own book on "Fires and Fire-engines," published while he was master of fire-engines in Edinburgh. "It has always appeared to me," writes Mr. Braidwood, "that an engine of *six*-inch barrels, is better suited for all ordinary purposes, than one either larger or smaller." He then goes on to explain his reasons for preferring this size, and furnishes a minute account, with detailed drawings, of an engine of that description. "A Fireman" seems to argue, that considerable obloquy attaches to Mr. Braidwood for this difference of opinion; I can only say that in each case I most cordially agree with him, and must therefore beg to share the obloquy. It is true, that Mr. Braidwood did not employ engines of this size, his opinion was the result of experience with engines both larger and smaller than the approved size; and so it is continually that a person may be satisfied of the superiority of one thing by the use of another, as "A Fireman" may hereafter become convinced of the value of truth, and that honesty is the best policy, without the actual use of either the one or the other.

The remarks in my last annual report on the "origin of fires" is designated by "a Fireman" as "a chapter of aspersions on the fire-brigade;" these "aspersions" are met with a tirade of abuse, which, from an anonymous writer, will have no more than their due weight with your readers. What "a Fireman" designates "aspersions," were merely offered as suggestions. When Mr. Braidwood assumed the superintendence of the London fire-establishment he had a mass of incongruous materials to organise and mould to an altered line of duty, and it would have been unreasonable to expect that much attention could be given to minute details, especially in matters not essential to the efficient working of the establishment. After twelve years' experience, however, when the routine duties had become well grounded, there did appear grounds for supposing that it was only to direct attention to subjects requiring improvement to ensure it; especially in matters so glaringly absurd as those to which I adverted, a state of things which "a Fireman" does not affect to deny or to justify. "A Fireman" carps at my objection to the present "manner" of reporting the causes of fire, and catches at the "Sunday working" as so "shocking to Mr. B. from its excessive puritanism." His soreness shows how keenly he felt the force of my remarks. Why, in the name of common sense, should such phrases as "Sunday working"—"late hours"—"old age," &c., be given as explanatory of the cause of fire? If a female is burned to death from her wearing apparel taking fire, why should the cause of fire be put under different heads according to the age of the party? Should the sufferer be young, the cause of accident will probably have been expressed by the unmeaning term of "curtain." But should the unfortunate victim be more advanced in life the cause will be attributed to "old age." Or, if a fire take place from "loose shavings"—"fire sparks"—"candles," &c.—why should the day of the week, or the hour of the day, take it out of the common category of causes, which must be the same whether the day be Sunday, or Monday—seven o'clock, or eleven. In one case a fire was said to be *caused* by "refusing to admit firemen!" If the fire had not occurred previously to their demanding admittance, what brought the firemen to the house? Are we to infer that the firemen paid a capricious visit to the house, and on being "refused admittance," in

* The alterations in size which "A Fireman" with the most daring effrontry denies, were faithfully chronicled (hitherto unquestioned) in my Annual Reports for 1838–9, vide *Mech. Mag.*, vol. xxx. p. 31, and vol. xxxii. p. 386.

a fit of anger fired the premises? The fact is, that the serious damage which subsequently ensued was the *consequence* of refusing the services of the firemen in the first instance; the CAUSE of the fire was another matter altogether. Having alluded to the disadvantages under which the reports as to the causes of fire are made, I expressed my regret that they were not subsequently corrected. "A Fireman" states that subsequent corrections are made; but to show upon what grounds I hold a contrary opinion, I beg to observe that at the end of every year a detailed report of the twelvemonth's fires, with the particulars of causes, &c., is sent round to the several fire offices, in which we might naturally look for the "subsequent corrections." Further, in 1843, Mr. Braidwood made a decennial return of London fires from 1833 to 1842 inclusive, a duly authenticated copy of which is now before me. In this return the total number of fires, the *causes* of which are "unknown" is 1407. In my annual reports for the same period, the number of fires whose causes are unknown, is 689. I am prepared to admit that some of the *causes* to which I have ascribed the origin of certain fires, might be objected to as "not proven;" in the majority of cases, however, subsequent investigation has satisfactorily shown the real cause of fire. The only object I had in view in originally adverting to this highly interesting subject, was to call attention to it as a thing of much importance in a statistical point of view. To quote the remarks of a recent writer, "The advantages of *correct* statistical information are too obvious to be insisted upon. In the business of legislation it forms a principal material, and it is amongst the most useful of the guides of science."

"A Fireman" appears wrathfully displeased at the bare mention of the possibility of being superseded by a well-organised and efficient metropolitan fire-police, to which I somewhat prophetically asserted "*we must come at last.*" A few short months will probably show that this desired consummation is much nearer at hand than I had ventured to anticipate, or than "A Fireman" will approve.

"A Fireman" indulges in an invidious sneer at that excellent corps, the *Liverpool fire-police*, and most unwarrantably, for had our London firemen (justly celebrated as they are) such fires, such premises, and such difficulties to deal with, there is no reason for supposing they would show to more advantage than their brethren of Liverpool. Our past experience at large fires in London, by no means warrants any such conclusion. Circumstances which are uncontrollable in Liverpool, would be equally unmanageable in London.

I had made it matter of just complaint, that in the measure recently submitted to Parliament, for the prevention of damage by fire in the metropolis, *property* alone was cared for, and that no protection for *life* was embodied in that measure. Certainly not, says "A Fireman," and for this reason—"Ministers found on enquiry at the Fire Brigade establishment, that during the eleven years commencing with 1833, the total number of persons who lost their lives by houses taking fire was only 71, *and that of these not more than fourteen could have been saved by means of fire-escapes*, being at the rate of little more than one a year." The odium of this astounding falsehood told to Ministers, being divided among so large a body as the "*Fire Brigade establishment*," gives hardly a bit a piece, and is therefore not worth talking about! But what are we to think of these same Ministers, who, on the receipt of such information (according to the statement of "A Fireman") set about compelling parishes to provide *fire-escapes* and keep them in constant readiness, at an expense of "not less than 25,000*l.* a year!" I have already shown your readers, in the words of the bill itself,* that the Ministerial measure contemplated *nothing of the kind*. The entire odium of this last falsehood belongs exclusively to "A Fireman," in addition to his infinitesimal share of the former one. The clause for saddling the metropolitan parishes with the maintenance of the Fire Brigade, stands conspicuous enough, but we may search the bill in vain for any mention of *fire-escapes*, or for any other provision for saving lives.

Besides, the idea of incurring *any expense* for the purpose of saving "little more than one life a year" is preposterous, and by no means in keeping with "the ways of this coarse, calculating, double-entry sort of world." Verily,

* Vide *Mech. Mag.*, vol. xlii. p. 185.

"A Fireman" is an apt and sad illustration of, "the chilling influences of calculating commercial policy."

I remain, Sir,

Yours respectfully,

WM. BADDELEY.

29, Alfred-street, Islington, Nov. 5, 1845.

SUBMARINE STEAM-LOCOMOTIVE ENGINE.

"The next person that addressed himself to the chief was a gentleman of a very mathematical turn, who valued himself upon the improvements he had made in several domestic machines, and now presented the plan of a new contrivance for cutting cabbages in such a manner as would secure the stock against the rotting rain, and enable it to produce a plenteous after-crop of delicious sprouts.

"In this important machine he had united the whole mechanic powers, with such massy complication of iron and wood, that it could not have been moved without the assistance of a horse, and a road made for the convenience of the draft.

"These objections were so obvious, that they occurred at first sight to the Inspector General, who greatly commended the invention, which he observed might be applied to several other useful purposes, could it once be rendered a little more portable and commodious.

"The inventor, who had not foreseen these difficulties, was not prepared to surmount them; but he took the hint in good part and promised to task his abilities anew in altering the construction of his design. Not but he underwent some severe irony from the rest of the *virtuosi* who complimented him upon the momentous improvement he had made, by which a family might save a dish of greens in a quarter, for so trifling an expense as that of purchasing, working, and maintaining such a stupendous machine."—Smollett—*Peregrine Pickle*.

"We have three that collect the experiments of all mechanical arts; and also of liberal sciences; and also of practices which are not brought into arts. These we call Mystery-Men."

Lord Bacon—*New Atlantis*.

Description of the House of Solomon.

Eagles' Crags, O'Connell Mountains, County Clare, November, 1845.

My dear and valued Friend,—I have headed this with the quotation from Smollet's *Peregrine Pickle*, in order to give proof that if any of your readers shall feel disposed to treat with good-humoured derision the mechanical constructions, *the principle* of which I am now through your pages about to submit to the world, as being preposterously complex in proportion to the value of the practical object to be attained by them; I anticipated their ridicule, and first good-humouredly laughed at myself, before giving them the opportunity. —But, notwithstanding this, they will perceive that I have also taken another quotation, that from Lord Bacon, and to this, *and peculiarly to its conclusion*, I pray permission to direct their most serious and earnest attention.

Sir Walter Scott describes the Vision of the Prophet Ezekiel, as "the gorgeous Vision of Ezekiel," and gorgeous it is indeed; a vision created under the *direct influence* of the Divinity inspiring the Prophet.

There is another "Gorgeous Vision" of later days, created by the *indirect* inspiration of the omnific, and omniscient and eternal and infinite—by the inspiration of an almost divine human genius.

That gorgeous vision is, *The New Atlantis* of Lord Bacon.

His eagle eye caught (as proved by that gorgeous vision, if he had never written anything besides,) far more than a rapidly evanishing glimpse, to quote from the Essay on the Human Understanding of the illustrious Locke, of "those masses of knowledge which still lie hidden within the secret recesses [of] Nature."

Now, in that gorgeous vision, [the] emanation and effluence of (I quote fr[om] a resplendent article on Bacon in [the] *Edinburgh Review*) "all the powers [of] the most exquisitely constructed int[el]lect that has ever been bestowed on a[ny] of the children of men," he has disdained to allude to that part alon[e]

the craft of the mystery men, which was the collecting of the experiments of all Mechanical Arts, and also of all liberal sciences; but also to the collecting of "*practices which are not brought into Arts.*"

Now, when we meditate and ponder upon the infinitude of the complexity of the operations, and of the combinations formed by the human mind in its state of highest exertion and tension in its methodized and elaborate investigations; and their infinite variety also in all the stages and gradations intermediary between that state of tension, and that other state, its opposite, in which without any kind of attempt at *mental effort* whatsoever, any more than in dreaming, combinations are made, and other infinitely diversified operations are carried on, in these reveries and dreamy visions, of value inestimable, (to take a metaphor from Navigation,) as *new departures* of the human spirit through "the void and formless infinite" of intellectual being.

Now, who can venture arrogantly to affirm, that the human spirit in its ethereal flight through things infinite, may not light upon *principles* of "practices not brought into arts," but which may in the performance of the duties of those professors named in *The New Atlantis* pioneers and miners, be made in their experiments, elements of transcendent interest in new combinations, although the "practices" merely by themselves in the hands of the inventors, may have been utterly barren, and without "*fruit*" to society. I use the term "*fruit;*" the Baconian word, indicating emphatically the object and end of the Baconian philosophy. With what exquisite poetical, and philosophical felicitousness of expression too, has another mighty spirit, Lord Byron, described that, which without mental effort and intention, sometimes evolves mighty results :—

> "And circumstance, that unspiritual god
> And miscreator,"

Results mighty and unexpected! The velocity, for example, attained by the locomotive engines in their first experiments in 1831 utterly transcended the anticipations even of the engineers by whom they were constructed. An ancient Greek writer describes the flying ram from which Helle fell into the Hellespont, as a vehicle of a nature exceeding credibility; for this I believe is the strict meaning of the Greek words σχηματος παραδοξον. That talisman of man's creation, the locomotive engine, may be described with felicitous exactitude, by these words of the Greek writer.

The summer before the last, having had an opportunity of study in the Richmond prison, by reason of the affectionate, the paternal solicitude of the Irish Court of Queen's Bench for my intellectual improvement, among some other first-rate works, after an interval of many years since I had read them before, I read the works of the stupendous mind of Bacon, —one of those almost miraculous

> "———— pure intelligential substances
> With thoughts which wander through eternity."

With the faults and errors, and vices and crimes of Bacon, his ingratitude to Essex, and his taking bribes as a judge, I, on this occasion, have nothing to do, except to deplore them, and to sigh forth in dreary sadness, Alas! poor human nature;—but with respect to his philosophical spirit, I firmly coincide in the opinion of the writer of the resplendent article in the *Edinburgh Review*, from which I have quoted, when he speaks of "all the powers of the most exquisitely constituted intellect that has ever been bestowed on any of the children of men." I made some extracts from the description of the *House of Solomon* in *The New Atlantis*, while a student in the academic bowers of the Judges of the Court of Queen's Bench; and it is quite in unison with the object of this essay to introduce them here.

The New Atlantis was a gorgeous vision, and it was also a prophetic one.

Read it, and then meditate on the steam-engine of Watt, with its almost divine parallel motion. Think of the mystic abyss of space, and of Lord Rosse's leviathan telescope, made as if the spirit of the maker had taken to itself "the wings of the morning"; of the electric telegraph;* of "the pencil of light," the Daguerreotype; of the Thames-tunnel; the Menai suspension-bridge; the power-loom; the wondrous

* In the vision of Ezekiel, it is said of "the living creatures," "whithersoever the spirit went they went, even as a flash of lightning they went and returned." By the action of the electric telegraph, thought, the emanation of the spirit of that living creature man, goes and returns;—yes, even *as a flash of lightning* it goes *and returns*; for the question asked is intervolved occultly in the answer which the electric talisman returns to the inquirer.

perfection of short-hand writing; the safety-lamp; the Eddystone light-house; gas-lighting; the exquisite perfection of surgical operations—"Hunt nature into her elements;" — the glorious discoveries of modern chemistry; Charles Green's aërial voyage to Nassau, and the horrific sublimity of his situation in a few moments after poor unfortunate Cocking had detached the parachute from the balloon; think of railways in their even *already diversified* modifications; and finally, contemplate the sublimity of ocean steaming; bring to your imagination the *Great Western* cleaving her way against the midnight billows, amidst the raving and howling and yelling of the tempest, and the glancing and flashing of lurid lightnings in the firmament. Above all, "*sibi gratulentur mortales tale tantumque extitisse* HUMANI GENERIS DECUS," meditate upon the experiments in optics of the divine Newton, and on his invention of the Fluxional Calculus; and his Principia; works worthy of being written at a time "when the morning stars sang together, and all the sons of God shouted for joy!"

The Irish name for the mariner's compass is *Anum a lingah;* which signifies, the Intellectual spirit—"*the mind of the ship.*" Oh! how many wonder-working "*minds*" of the same kind; how many other mirific souls of matter, may not yet be evolved from their present state of torpor "within the secret recesses of nature"!!!*

Although anticipated by the little water-spider in the practical application of the principle; the piston-rod of his condensing-air pump is to the diver in his submarine (or rather subaqueous) pavilion, as the rod of Moses which laid dry the bottom of the sea. But, although this be so, the science of subaqueous operations is as yet in its utter infancy.

Before I proceed further, I shall give the extracts from the description of the *House of Solomon* and of the professors.

* * * * *

"We have also engine-houses, where are prepared engines and instruments for all sorts of motions; there we imitate and practise, to make swifter motions than any you have, either out of your muskets, or any engine that you have: and to make them and multiply them more easily with small force by wheeles and other means, and to make them stronger and more violent than yours are; your greatest cannons and basilisks.

* * * * *

"We have some degrees of flying in the air; we have ships and boats for going under water, and brooking the seas; *

* * * *

"These are (my sonne) the riches of Salloman's House.

"For the several employments and offices of our fellows, we have twelve that sayle into forraigne countries under the names of other nations, (for our owne we conceale,) who bring us the books and abstracts, and patternes of experiments of all other parts. These we call Merchants of Light.

"We have three that collect the experiments which are in all bookes. These we call Depredators.

"We have three that collect the experiments of all mechanicall arts, and also of liberall sciences, and also of practices which are not brought into arts. These we call Mystery-men.

"We have three that trie new experiments, such as themselves think good. These we call Pioneers, or Miners.

"We have three that draw the experiments of the former fowre into titles and tables, to give the better light for the drawing of observations and axiomes out of them. These we call Compilers.

"We have three that bend themselves, looking into the experiments of their fellows, and cast about how to draw out of them things of Vse, and practise for man's life, and knowledge, as well for workes as for plaine demonstration of causes, meanes of naturall divinations, and the easie and cleare discoverie of the virtues and parts of bodies. These we call Dowry Men, or Benefactors.

"Then after diverse meetings and consults of our whole number, to consider of the former labours and collections, we have three that take care ou[t] [o]f them to direct new experiments of hig[he]r light, more penetrating into nature th[a]n the former. These we call Lamps.

"We have three others that doe e[x]ecute the experiments so directed, [an]d report them. These we call Inocu[la]tors.

"Lastly, we have three that raise [th]e former discoveries by experiments i[nt]o

* See the Bridgewater Treatise, and the *Mechanics' Magazine.*

greater observations, axiomes, and aphorismes.

'These we call Interpreters of Nature.

"We have also, as you must thinke, novices and apprentices that the succession of the former employed men doe not faile; besides a great number of servants and attendants, men and women. And this we doe also: we have consultations which of the inventions and experiences which we have discovered shall be published, and which not: and take all an oath of secrecie for the concealing of those which we think fit to keepe a secret. Though some of those we doe reveal sometime to the state, and some not.

"We have circuits or visits of divers principall cities of the kingdom: where it cometh to passe we doe publish such new profitable inventions as we think good.

"We have two very long and faire galleries: in one, patternes and samples of all manner of the more rare and excellent inventions and statues of all principall inventors.

* * * *

"I give thee leave to publish it for the good of other nations; for we here are in God's bosome, a land unknown." —*New Atlantis.**

In the water-tight dress and diving-helmet I some time ago made a descent (going to the bottom by the ladder) upon the bed of the wreck of the *Mary Rose*, a war-ship sunk at Spithead, in the reign of Henry the Eighth, and now embedded in the sand. I went down for the purpose of making some experiments in submarine illumination in that gloomy water; that "melancholy flood.":

Oh! what a contrast between it and the crystalline clearness of the waters of the Atlantic on the romantic coast of this county, Clare, on a bright sunny day.

The position of the *Mary Rose* was accidentally discovered by some Portsmouth fishermen, by a metallic appearance on the ropes of their nets caused by attrition against (most probably) her splendid brass guns, some of which have been recovered by my friends, Mr. Deane and Mr. Edwards, the divers.

There are eight fathoms of water, at low water, over the sand in which the wreck is embedded; and it lies not far from the spot where the *Royal George* went down.

The splendid brass guns are perfect, the iron ones greatly corroded; some long bows of yew still retain, after their long submersion, a dull elasticity.

Some skulls were also found, but whether their brains were dull or elastic during their life-time, I am not able to tell you.

I of course suffered the painful sensation in the ears, created by the pressure of the condensed air; and in the helmet I could not even mitigate it for want of room to use my handkerchief, as I could in the common diving bell, all open at the bottom.

Had I gone down in my own bell, the "Communicating Diving Bell," for the invention of which I was honoured by being admitted a member of that noble body, the London Institution of Civil Engineers; and for which I received the most flattering testimonials of the approbation of those illustrious philosophers, Sir Humphry Davy, Dr. Woolaston, and Professor Sedgewick of Cambridge; it is not necessary that I should tell you, or any one else who knows its construction, that I could have sat in it quite as much at my ease, and holding conversation with my friends above water, as if I were sitting in a travelling chariot, or a railway carriage; or in the Thames Tunnel.

Now an application of *the principle of*

* *Note.*—I have had two petitions presented to the House of Commons for the erection of a magnificent dome over the house and observatory of the house in London, near Leicester-square, in which Newton resided.

The plan was suggested to me by seeing the Dome of the Great Church of Assisi, in Italy, thrown over the primitive cottage, like the Chapel of St. Francis.

The prediction with which I concluded the second petition presented by Mr. Hume, is destined to be fulfilled; the first was presented by Lord Monteagle, when Mr. Spring Rice, in the House of Commons.

I expressed a hope that the prayer of the petition would not be rejected, "at a time when the light of science sheds an elysian effluence over the world; although it be now, in comparison with what it will be hereafter, only as the cool dewy roseate dawn of a roseal blushing morn, in comparion with the meridian torrid glory of 'the arch-chemick sun.'"

construction of that bell, it is quite manifest, would enable any one, for example, a lady not choosing to endure the painful sensation to which I have alluded, to be drawn (for example across the bottom of the Thames over the line of the Tunnel,) by a horse or horses pacing on that bottom, and as much at her ease as if in her carriage. She might, it is also quite evident to you, (indeed I showed it to you,) be wheeled about at the bottom, at the very *maximum* depth at which divers can descend either in the open bell, or diving-dress and helmet.

During this excursion she could converse with her friends and acquaintance above water, or read or write, if she pleased, by the light of a lamp or candles, either in her own apartment—[" *The Communicating Chamber*,"] or in the open Bell.

These are perfectly simple and obvious results of *the principle* of construction of my bell; but the following theorem is not so simple and obvious, for it did not occur to me until two or three days before I lately called on you in your study in London, to talk over the subject, and to give you the demonstration.

A diving bell may, as I then showed you, be constructed, *not* of course *in size and form*, exactly like my own, but *absolutely identical with it* in mechanical and pneumatical PRINCIPLE of CONSTRUCTION, which may be moved on the bottom itself of the water, or on a railway formed on the bottom, by the power of a steam-engine contained in the very machine itself adown beneath the flood, while wheeling over the bottom, or on the rails.

I talk of the mere theory; for actually to construct such a machine, even if I could afford it, would be more preposterous than the construction of the cabbage cutting machine described at the meeting of the *virtuosi* in *Peregrine Pickle*.

If I had the treasures of the Rothschilds, I would not subject myself to the ridicule of putting together the machinery, for it would be only an expensive and fantastic scientific toy.

Ariosto replied most sensibly to some observations made to him on the contrast between his poetical descriptions of magnificent architecture, and the quiet plainness of his own dwelling-house. "Words are much more easily put together than bricks," said the illustrious author of the *Orlando Furioso*. It is not quite impossible that you may have heard it before, but if not, I will tell it to you as a solemn scientific secret, that "words" of description, and diagrams and drawings are much more easily put together than complex and expensive machinery.

Without asking (you see what a very considerate person I am) your readers to go through all I have written in your Magazine for the last twenty years on diving operations, and submarine illumination, I will just say concisely, as necessary explanatory matter for elucidation, that "The communicating diving-bell" in *its simplest form*, (I now omit allusion to the air-chamber filled with condensed air above water,) consists of two compartments, separated by a partition with a little window of immensely strong glass, to resist the pressure.

One of these apartments is nothing more or less than the common diving-bell open at the bottom. The second apartment has a bottom, and I need not say that the aperture through which I enter it, is made perfectly water-tight before I descend. This apartment is supplied by tubes with atmospheric air; for having a bottom, there is no necessity for condensation. Through one of these tubes I hold conversation.

It is obvious at a glance from this most concise description, that a fantastic scientific toy might be constructed with a steam engine in the compartment with the bottom; that compartment being of course made of very capacious dimensions.

It is quite evident that the rectilineal motion of the piston might be converted into a circular one above water, by a crank; and it is also quite manifest that this being done, a communication might be established which would give motion to wheels on which the machine might be moved, for example, on a railway at the bottom.

I am not a "mystery man," I am only one of the humblest, and I hope, m[illegible]t industrious of the "Apprentices" [illegible]n "the House of Salomann," and I g[illegible]e this as one of "the practices not broug[illegible]t into art," viz., my practices of creati[illegible]g dreamy reveries in submarine theorizi[illegible].

But although this theorem which I have just propounded, be merely a[illegible]e creation of my brain, without "fru[illegible]" and useless to the world; who can tell [illegible]t

within a week some one of my most kind and most respected brothers of our London Institution, or some other engineer, or man of science, may ground upon it some novel combinations, leading remotely, or perhaps even immediately, and directly, to important scientific results and developments, and never forgetting the aphorism in the *Novum Organum*, "Natura enim non nisi parendo Vincitur," may become a *Dowry man*, and *Benefactor* to the human family.

The splendid writer of the article on Montague's Bacon, in the *Edinburgh Review*, says most truly of *The New Atlantis*, that "there is not in any human composition a passage more eminently distinguished for profound *and serene* wisdom."*

What a glorious profession is that of the civil engineer; if he combine high moral character with splendid intellectual powers in his profession, how exalted is his place in the scale of human society, in the social system of the world!

Every civil engineer who really enters into the spirit of this department of human science, must be by inevitable *vis consequentiæ*, a Baconian philosopher, for he proposes to himself the same end as did that illustrious philosopher.

In proof of this, I conclude by two quotations from the same Review.

"What then was the end which Bacon proposed to himself?

"It was, to use his own emphatic expression, '*fruit*.'

"It was the multiplying of human enjoyments, and the mitigating of human sufferings. It was 'the relief of man's estate.'* It was 'commodis humanis inservire.'† It was 'efficaciter operari ad sublevanda vitæ humanæ incommoda.'‡ It was 'dotare vitam humanam novis inventis et copiis.'§ It was 'genus humanum novis operibus et potestatibus continuo dotare.'‖

"This was the object of his speculations in every department of science, in natural philosophy, in legislation, in politics, in morals."

* * * * *

"We have sometimes thought that an amusing fiction might be written, in which a disciple of Epictetus and a disciple of Bacon should be introduced as fellow-travellers. They come to a village where the small-pox has just begun to rage; and find houses shut up, intercourse suspended, the sick abandoned, mothers weeping in terror over their children. The Stoic assures the dismayed population that there is nothing bad in the small-pox, and that to a wise man, disease, deformity, death, the loss of friends, are not evils. The Baconian takes out a lancet, and begins to vaccinate. They find a body of miners in great dismay;—an explosion of noisome vapours has just killed many of those who were at work; and the survivors are afraid to venture into the cavern. The Stoic assures them that such an accident is nothing but a mere αποπροηγμενον. The Baconian, who has no such fine word at his command, contents himself with devising a safety lamp. They find a shipwrecked merchant wringing his hands on the shore; his vessel, with an inestimable cargo, has just gone down, and he is reduced in a moment from opulence to beggary. The Stoic exhorts him not to seek happiness in things which lie without himself, and repeats the whole chapter of Epictetus πρὸς τοὺς τὴν ἀπορίαν δεδοῖχοτας. The Baconian constructs a diving-bell, goes down in it, and returns with the most precious effects from the wreck.

"It would be easy to multiply illustrations of the difference between the philosophy of thorns and the philosophy of fruit—the philosophy of words and the philosophy of works."*—*Edinburgh Review.*

I remain, my dear friend,
With the deepest esteem,
Ever yours,
THOMAS STEELE,
M.A., Magdalen College, Cambridge; A Member of the London Institution of Civil Engineers.

THE ATMOSPHERIC "VERSUS" LOCOMOTIVE SYSTEM.

Sir,—It having been now, I think, proved, that the atmospheric principle of

* Advancement of Learning. Book I.
† *De Augmentis.* Lib 7.
‡ *De Augmentis.* Lib. 2. Chap. 2.
§ *Novum Organum.* Lib. I. Aph. 81.
‖ *Cogitata et visa.*

* I would most earnestly recommend the careful perusal of this exquisite article in the *Edinburgh Review* to any of the readers of the *Mechanics' Magazine*, who may not yet have read it. I would also suggest a careful reference to the passages in the works of Aristotle, to which the writer of it refers, on the subject of *Induction*.

railway possesses many advantages over the locomotive, as regards very greatly a saving both in the expense of construction and in the after management; danger to life and property reduced to a mere cipher; and steam, smoke, and falling flakes of fire, entirely done away with: whilst, on the other hand, it possesses in a superior degree a facility of working with perfect safety at a high speed, for there can be no collision, or running off the line, and a power of ascending inclined planes, that was before considered impossible for any vehicle to accomplish. Such being the case, the atmospheric system must have the preference in the future construction of railways; and it only becomes necessary that caution be exercised in selecting the most perfect plan with the least possible expense; for the shortly expected vast increase to the existing lines will require a great amount of capital, and parties investing their property will do well to see that it is judiciously made use of. I will point out what I think may be considered objectionable points in the system of atmospheric propulsion now before the public, but feel satisfied improvements will yet be made to render them all that can be desired. A valve formed similar to that upon the Croydon line tube, is objectionable on account of the composition required to keep it air tight, the necessary continual supply being a heavy expense; so also are the many attendants this department requires throughout the line, and the furnace under the carriage (to heat the copper bar, for melting the composition) which is injudicious, and attended with danger under any circumstances. The short plates of iron on each side of the leathern flap or valve, must, from the nature of their action, rapidly destroy and render useless the leather; added to which, stones and other hard substances will be continually liable to get under them. In the system introduced, known as Pilbrow's, there is great liability to derangement of the principal working parts; the friction being very great, very considerable power must be lost. The piston being in advance of the rack, does not remove the great pressure of the atmosphere from the spindles; this is very apparent, but even the small amount of air admitted at the very moment of the piston head passing a pair of spindles, is next to useless; for, to be really effective in removing the atmospheric pressure, the admitted air would greatly impede the piston's speed; and as this must take place at every thirty feet, the loss of power would prove very great. The *carriage* and its rack must be about 11 *yards* long; and as the spindles are ten yards apart, in every mile, there will be the very heavy expense of constructing and keeping in repair and oil, the complicated action and friction of 176 pair. The application of the break as applied to this system, must have in practice a violent and unpleasant effect, and subject many parts to great wear. When these objections are removed, and it will not I think be long or difficult to accomplish, we shall find the atmospheric system of propulsion in every respect most advantageous. For instance, the expense will be one-half reduced,—the great weight of every engine and tender will be converted into so much profit by goods, &c.; the rails and other parts will be no longer liable to injury—the maximum of speed will be attained with perfect safety, and the power of surmounting declivities, and consequent shortening of distances will be the saving of much labour.

OMEGA.

TRUMAN'S PATENT FILTER.

Sir,—I have no doubt Mr. Truman considered himself the first inventor of the filter described in your No. 1149, (16th August, 1845) p. 98; otherwise he would never have been at the expense of taking out a patent for an invention which had been previously given to the public in the pages of your widely circulated Magazine. In No. 1114, for Dec. 14, 1844, I gave a description and drawing of this identical species of filter, which Mr. Truman has since taken out a patent for, as any one may be convinced of by turning to the communication referred to. My immediate object in that communication was, to point out the advantage of introducing water at the bottom instead of the top of water-butts, reservoirs, &c.; and I availed myself of the opportunity to illustrate its use and application in the case of what appeared to me an ingenious invention, and a most efficient filter, but which I believed to be little known. I made no pretension to the invention of the filter, but describe it as I saw it in the house of a friend. I do not know where it originated, nor have I ever met with it except in the town I reside in. But whether its use was more or less

known, it is not for any person in February, 1845 to claim a privileged right to an invention, which was fully described and given to the public in your pages one, two, or more months before any such claim was preferred. In every essential particular, the first of Mr. Truman's arrangements, as given in No. 1149, which contains the whole principle of the invention, is the same as the apparatus described by me: the close hollow vessel of porous stone into which the water filtrates, placed in another filled with the water to be filtered; the tap for drawing off the filtered water, and the air tube rising above the surface of the water in the external vessel, are the same in both; except that in the arrangement I described, the air tube was recurved at top to prevent the entrance of dust, which most persons will consider a decided advantage over Mr. Truman's straight air tube. However hard it may press on Mr. Truman in a pecuniary point of view, it is plain his patent is without any validity in law; for the public cannot be debarred from the *free* use of an invention which it has once been put in possession of.

I am, Sir, &c.,

N. N. L.

8th Sept., 1845.

MODE OF SWEETENING BUTTER.

Sir,—Believing the following discovery will add to the dietetic comfort of numerous individuals, will you favour me by printing it in the columns of your widely circulated Magazine?

I remain, yours faithfully,

ARTHUR TREVELYAN.

Wallington, Morpeth, Nov. 19th.

Whilst lately engaged making some experiments, it occurred to me that butter, either fresh or salt, possessing a disagreeable effluvium and flavour, might be rendered perfectly sweet, by the addition of a little carbonate of soda. On trial, this surmise proved correct. The proportions are—Carbonate soda, 2½ drams to butter 3 lbs. In making fresh butter, the soda is to be added after all the milk is washed out, and it is ready for making up. The unpleasant smell is produced by an acid, which being neutralized by the alkali, disperses at the same time the disagreeable flavour. This acid is generated by peculiarities in the constitutions of some cows, by the condition of certain fodders, by the length of time the cream is kept before being churned, but too often by the dairy utensils not being kept thoroughly clean. Soda produces the same results when added to the culinary greases, as dripping, lard, &c.

THE GREAT BRITAIN—FOURTH VOYAGE.

The *Great Britain* arrived in the Mersey on Monday last, after another long and somewhat hazardous voyage, the circumstances of which will be found fully explained in the subjoined documents.

Address from the Passengers to Captain Hosken.

"Circumstances attending the late passage of the steam-ship *Great Britain* render it a pleasing duty on the part of the undersigned cabin passengers to submit the following brief statement to the public:—

"The *Great Britain* left New York on the 28th ult. with every prospect of making a good passage. It is true that on her outward trip she met with an accident to her propeller, which rendered important repairs necessary before leaving on her return to Liverpool; and these were done in a manner which was hoped to be efficient and substantial.

"Scarcely, however, had she been at sea 48 hours when an accident occurred similar to that which befel her on her previous passage—the loss of one of the arms of the propeller. Again, and when but a few days longer at sea, two more of the arms of the propeller were carried away, and the ship was now so far disabled that her commander deemed it prudent to discontinue the use of the engines, and to depend entirely for the remainder of the passage on the good qualities of his ship as a sailing vessel. Favourable weather soon gave us the opportunity of testing her ability in this character, and from what we then experienced we have no hesitation in saying that, in our opinion, her ability as a sailing vessel is not inferior to any ship afloat. We overtook several vessels at sea sailing in the same course, all of which we passed. This fact we deem as the best evidence of her qualities as a sailing ship.

"On the 10th instant we experienced a very heavy gale from the north-west, which continued for nearly 24 hours, and we then had an excellent opportunity of judging of her strength and ability as a sea-boat. Far from encouraging any of the ill-founded prejudices against the *Great Britain*, she, on this occasion, strengthened our confidence, and won the admiration of all on board.

"Those of us who have experienced severe weather on the Atlantic cannot refrain from expressing the opinion of the superiority of the *Great Britain* in a heavy gale; and we venture to predict, that if she should ever encounter worse weather than she has already, she will sustain her character as one of the ablest triumphs of modern naval architecture.

"In conclusion, we take pleasure in mak-

ing public the statement that we are well pleased with the *Great Britain* in every respect. For safety, speed, and comfort, she is, in our opinion, unsurpassed; and during this passage of unexpected length, we have not suffered the slightest diminution of comfort, and, in particular, our table has been as good and well supplied as if we had been only the usual period.

"We must now express our high opinion of the commander, Captain Hosken, R.N., under the trying circumstances of such a passage; and we gladly bear testimony to his perseverance in difficulty, and his good judgment and skill throughout.

"H. Cocker
J. A. Robertson,
Capt. 82nd Rgt.
W. B. Wedgewood
C. A. Cuthbert, Lt.
65th Regiment
J. A. Gunning, late
Hon. E.I.C.
G. F. Orde
H. J. Ibbotson
"E. Hope
W. Cockercroft
W. King
T. O'Conner
C. Tuckness
G. Tomes
D. Whitley
J. M'Call
J. Davis, Lt. R.N."

Extracts from the Great Britain's Log.

Oct. 18th.—Saturday noon went on sectional dock (at New York); found two arms gone close to the boss, and one blade; shifted the blade of the remaining arm to the opposite side, and secured the other blades; the rivets were nearly all loose; came off the dock.

28th.—Started at 2 p.m. on Tuesday, with low steam, cut off at 13 inches; ship in good trim, 18 ft. 8 inches, 17 ft. 6 inches, and going very well until 11 p.m. the 30th, when we found something wrong with the propeller, and striking the stern-post very hard; reversed the engines, and, after two or three good thumps, the arm broke off.

Went on with very low steam, cut off at 12 inches, steered by the sails; wind north-easterly; ship making very good way, seven to nine knots, until Friday, the 1st, about 3 p.m., when another of the arms of the propeller broke, leaving only one, I think the repaired one, and the half of another, with a small plate we had put on the end of it.

Wind hauled to the southward and south-westerly; made the most of our sails, and very fair way, just keeping the propeller from dragging, at times going 10 knots.

Nov. 3rd.—Wind fell to a calm on the evening of the 3rd, making 5 knots, and in the course of the night came a-head, a moderate breeze from the eastward, and little swell, ship making 3½ knots against it.

4th.—Have been economising water and provisions since we broke first arm off, and estimate we have at least 30 days', from to-day, of everything, without going on short allowance.

5th.—Very fine weather, with N.E. swell; wind veered round to the N.W. and squally, then to the N.E. and easterly.

6th.—Made use of our sails whenever there was a chance, within three points of her course; she feels them directly, and has, I think, very superior sailing qualities. Every appearance of westerly winds the last three days, but have been disappointed so far; yet we have made, under the circumstances, very good way indeed.

The propeller, or what is left of it, has done wonders, at times making four knots against a moderate easterly wind, and N.E. swell, rather high. Wind hauling from eastward to southward this morning, and, I think, looks well for a south-wester very soon; making 8½, close as she can lay, with fore and aft sails, reefed topsail and mainsail; this is good decidedly.

About a quarter past 5 the remaining arm of the propeller broke, leaving only a half arm, and the small piece of another, about two feet from the centre.

Cut steam down as low as possible, going all night, with a fine southerly breeze.

8th.—At 1h. 20m. p.m., stopped the engines, with the half-arm verticle; moderate south-westerly winds; all sails we can carry set. Wind freshened gradually to a gale from the westward; reefed topsail, and off bonnets of spencers; sea rising fast; increased breezes to fresh gales, and hard squalls and high sea; mainsail, topsail, and one spencer set, ship scudding and steering beautifully, taking a spray on larboard-quarter and beam occasionally, but as easy, or easier, than any ship I ever knew.

10th.—Passed a large ship, hove-to with maintopsail and foresail; dirty rainy weather; dead lights all closed, scuttles, &c., well secured.

11th.—Wind moderating and hawling to the northward; made all sail on her; wind to the N.E. and E. Noon.—Saw two ships ahead, and came up with them, at the rate of two miles an hour, close hauled. This is wonderful with our little spread of canvass, and more than I expected, well as I thought of her sailing qualities. Wind variable, and getting light.

12th.—Light breezes inclined to the N.W. again; a ship in sight that we are coming up with as fast as those yesterday.

13th.—A light breeze from the S.W.; increased to a moderate breeze and fine weather; a ship astern at daylight; ran her out of sight by noon. Wind fell light again in the evening.

14th.—A breeze sprang up from S.W.; made all sail; at noon increased to a gale;

double-reefed topsail and off bonnets of spencers; dirty rainy weather, and sea rising fast; moderating, and hauling to the W.N.W. in the evening.

15.—Moderate and cloudy; high N.W. swell; made all sail; 8h. 30m. lighted fires; increased to strong breezes, and squally, southerly, very thick, dirty, rainy weather.

16.—Daylight; cleared off, and saw the mizen-head; a fine breeze all day; running 10 and 11 knots.

17th.—At 1h. 30m. passed the Tuskar; 11 off Holyhead; 1 p.m. off Point Lynas; 8 p.m. got a pilot and steam-tugs off N.W. light vessel; waiting for water.

THE WATCH TRADE.

In the table of restrictions and prohibitions with respect to the exportation of goods and merchandise generally from any port of the united kingdom to foreign parts set forth in 104th section of the Regulation Act of the 3rd and 4th William IV., cap. 52, the provisions of which are re-enacted in the 8th and 9th Victoria, cap. 86, of the past session, clocks and watches, that is to say, any outward or inward box, case, or dial-plate of any metal, without the movement in or with such box, case, or dial-plate, in every instance, made up fit for the use, with the clock or watchmaker's name engraven thereon in a legible and permanent manner, are prohibited to be so exported from the united kingdom; and by the 31st section of the act of the 3rd and 4th William IV., cap. 53, re-enacted in the 32nd section of the 8th and 9th Victoria, cap. 87 of the past session, (we enumerate these acts thus fully and severally, because in the last session of Parliament the whole of the laws relating to commerce and navigation underwent a revision, repeal, or re-adoption, as was considered expedient,) any goods prohibited to be exported, which shall be brought to any wharf, quay, or other place for shipment, are forfeited. Some little time back a party entered at one of the outports, having an extensive and frequent communication with the Continent, a package containing several dozens of British-made watch dial-plates for shipment to the Continent; which were, on examination, seized by the revenue officers, as prohibited under the several acts of Parliament above mentioned to be so exported. The party subsequently made an application to the authorities for their release, and, in order to avoid the application of the law in the matter with an undue severity, as the goods were about to be shipped in a regular manner, a reference was made to some parties in the trade, who, from their extensive dealings in the trade, and experience in the matter, possessed a correct knowledge of the intention of the Legislature in respect thereto, with reference to the British manufacture of such articles; when it appearing that the dial-plates alluded to, which were enamelled on metal, fell within the prohibition, and were consequently liable to forfeiture, the application was rejected, and the goods ordered to be confiscated, and on a recent further memorial on the subject to the higher quarters, the order for their confiscation has been confirmed. The principal portion of the watch-dials in this instance were marked with a foreign maker's name and place of abode, and a few with that of the exporter, a foreigner, with the word "London" thereon. This latter infringement of the law, in so far as an evident intention existed of, when united to works of foreign make, giving them a British character abroad or at home, in direct opposition to the act relating thereto, would have been sufficient to cause their detention; but the advantage of exporting the dials or faces of watches, unconnected with any movements or works, at the same time regularly marked with the name and abode of a foreign maker, does not so readily appear. The fact is, that the faces or dials of watches, when not made of gold or silver, were formerly composed entirely of enamel, which enamel was imported into this country from the Venetian states for the purpose of manufacture; but, at the period of the disturbances on the Continent, its importation from that quarter was partially, and after a time, totally prevented. The enamel was subsequently composed in this country, but of a quality much inferior to that of the Venetian make. The attention of the trade was then directed to the substitution of a substance in lieu, and to answer the purpose of enamel, and by far the greater proportion of the watches now made, and especially those brought from the Continent, have their faces, when not of gold or silver, made of a prepared glass, manufactured expressly for the purpose, which looks well at first, equally with enamel, but is more liable to become injured or disfigured, and after a certain lapse of time loses its bright appearance, which is not the case with enamel. As may be supposed, the cost of an enamel dial is infinitely greater than one composed of glass, and is more valuable in proportion to its solidity and durability. It may be inferred, therefore, that, the intention of the shipper of the dials alluded to, which were composed of enamel, was to enable a foreign manufacturer to make his watches more valuable by the substitution of the better and more lasting material for his dial plates than that now commonly in use.—*Times*.

NOTES AND NOTICES.

Suspension Bridges.—Mr. Dredge has just completed two bridges in Ireland, one across the River Bann, county Down, the other over the Blackwater, county Tyrone. This last is for the Earl of Caledon, and is the second built across the same river—which Mr. Dredge has built for his Lordship within the last year, and the fourth he has erected within the last four months. Two of them are county bridges, and all of them are calculated to sustain a heavier load than can possibly come upon them.

The Iron Age.—It is now upwards of 5,000 years since Vulcan began business: but we question if he ever had so many orders as at present—never so many forges at work—never so many "artificers in brass and iron" to instruct. This is, indeed, "the iron age!" But the poets were not true prophets, who sung of the miseries of mankind during that age; for Midas has touched it, and, by a most potent alchymy, has turned it into *gold!* Witness the millions accumulated by those men of iron, the Guests, the Crawshays, the Thompsons, the Hudsons, and other *millionaires* of the present day. Industry, directed by science and skill, is, after all, the real alchymist; by exploring the bowels of the earth, and bringing up to light its mineral treasures, even of the coarsest kind, and by applying them to the commerce and convenience of human life, she enriches and improves the most extensive populations.—*Boulogne News.*

Dr. Payerne's Diving Bell.—Some short time since, Dr. Payerne descended in a diving bell, at the quay of Orsai, in presence of MM. Mallet and Frisseau, divisional inspectors, delegated, in connexion with him, by the French Minister of Public Works, to assist in experiments for the purification of air by his new process, when the following observations were made:—At 8h. 0m.—water below the mark, 0·76: pulsations per minute, 84; manometer, about one-ninth of the atmosphere? thermometer, 18. deg. At 8h. 12m.—the water below the mark, 0·71. Whilst descending there was merely felt a slight sensation about the eyes, which speedily ceased when the bell had reached the bottom. At 8h. 12m. some of the compressed air was let off, this immediately obtained an agreeable cool atmosphere. With closed cock, at 8h. 14m.—water, 0·80; pulsations, 81; 8h. 32m.—water, 0·71; thermometer, 22 deg.; manometer, 9; pulsations, 81. 8h. 47m.—water, 0·64; thermometer, 23 deg.; manometer, 9; pulsation, 81. No uneasiness whatever was experienced, the experimentalists merely feeling a little heated. A powerful ventilator in the square part of the bell caused a continual humming. 9h. 0m.—water, 0·61; thermometer, 24 deg.; manometer, ·6; pulsations, 80. At 9h. 3m., the cock of the compressed air was opened, and the air found cool with an agreeable breeze. At 9h. 9m. the water being at 0·69, no more compressed air was left. At 9h. 17m.—water, 0·62; thermometer, 25. deg.; manometer, ·6; pulsations, 82. At 9h. 39m.—water, 59; thermometer, 25 deg.; manometer, 6; pulsations, ·82. At 9h. 49m. water, 0·59; thermometer, 25 deg.; manometer, 6; pulsations, 82. Similar experiments were continued till 11 o'clock, when the last observations gave—water, 0·57; thermometer, 25½, manometer, one-seventh; pulsations, 86. These results are considered highly satisfactory, and confirmatory of the applicability of the process. For a description of Dr. Payerne's apparatus, see *Mech. Mag.*, vol. xl., p. 1.

Increasing the Adhesion of Railway Carriages by Magnetism.—Dr. Wright, of Pittsburg, has made an application of magnetism to locomotives, which, if successful in practice will be of great importance. It is well-known (says the *Pittsburg Gazette*) that locomotives of great weight are used upon our railroads, made so not for the strength or power, but solely for the purpose of procuring that degree of adhesion to the rail without which friction up-hill cannot be accomplished. Dr. Wright proposes to effect this adhesion by simply, at will, as the occasion may demand, converting by means of galvanism, the periphery of the driving wheel into a powerful magnet. Its application is very simple, and it is calculated that it will give each wheel an adhesive force of two thousand pounds additional to what it has from its weight; it follows of course, that a given force applied in propulsion, will be more efficient, as there will be less weight to be moved, and the tendency of weight having to run down hill instead of up will not have to be overcome in so great a degree, by mere force of steam.

American Iron.—A Liverpool merchant, who went through the American iron-works in August last, writes as follows:—"Mr. Wemslow, of Tray Iron-Works, says that the owners of the Danville furnaces have contracted with the owners of the mills and forges to supply them with their pigs at 11 dollars per ton, or about 2*l.* 5*s.* of our money; and they have contracted for a supply of coals, which are got close to the works, for 1¼ dollars, or 5*s.* per ton; and he says he has no doubt but that, in a short time, they will be able to make their pigs for 8 dollars per ton. You may judge for yourselves, therefore, what chance we have of long competing with these people. Charcoal blooms are now at 50 dollars, or above 10*l.* per ton sterling." And he adds, in regard to wages—"The average wages of the workmen is about 3*s.* 6*d.* sterling per day, paid in truck at the employer's store, in provisions, clothing, &c., for which they pay 25 per cent., and in some cases higher, than they would buy them for at the regular stores."—*Scottish Railway Gazette.*

Wear of Railway Iron.—From some returns connected with the working of the Lowell Railway, in the United States, we are enabled to give a pretty correct account of the durability of railway iron, 56 lbs. to the yard. It appears that the first ten miles of the second track of this road was first opened in 1838, at which time an H rail was substituted for the fish-belly pattern, which had been found inadequate. From 1838 to July last, a period of seven and a half years, the total quantity of merchandise which passed over the line was about 720,000 tons, and of passengers and goods 120,000 tons—making a total of 840,000 tons, only one-half of which, or 420,000 tons, passed over the second track. In 1844, the company were obliged to remove considerable lengths of these rails, and substitute new; and, from the continuance of these repairs, it is highly probable the whole ten miles will be changed in the course of the next year—thus making its durability equal to 500,000 tons in eight and a half years; the generally estimated wear being 1,000,000 tons. The iron now being laid down is 63 lbs. to the yard, and costs the company about 4,700 dollars per mile. Dividing this sum by 500,000 tons, the amount of traffic which has worn it out, the result is one cent. per ton per mile; and the company receiving five cents. per ton per mile for their freight, leaves them four cents. per ton per mile to cover the other working expenses, interest, dividends, &c.—*Mining Journal.*

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1164.] SATURDAY, NOVEMBER 29, 1845. [Price 6*d*.

Edited by J. C. Robertson, No. 166, Fleet-street. Double.

LYTTLETON'S AQUATIC SCREW PROPELLER.

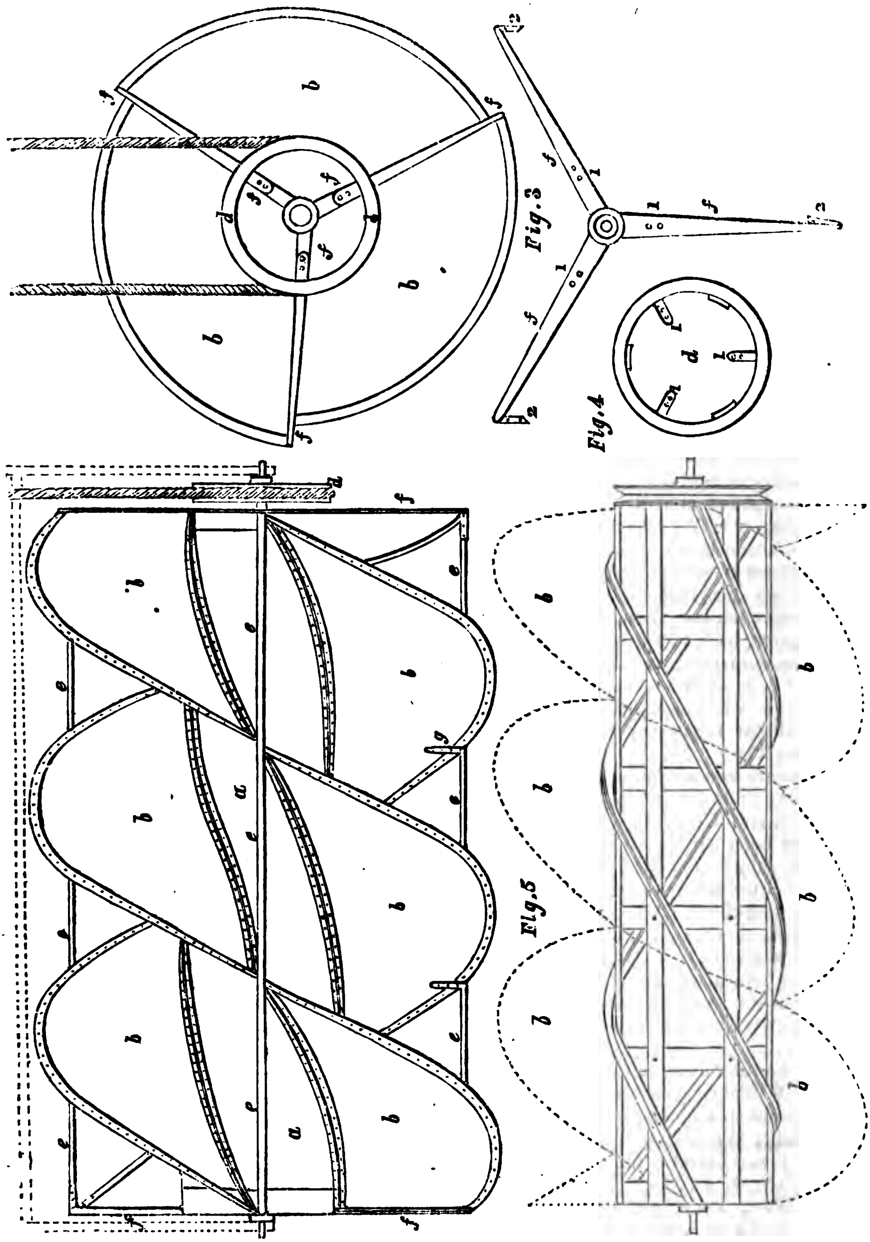


Fig. 2.

Fig. 1.

LYTTLETON'S AQUATIC SCREW PROPELLER—A PATENT INVENTION OF THE LAST CENTURY.

Fig. 6.

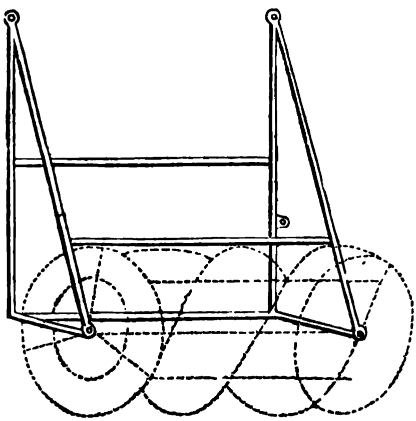
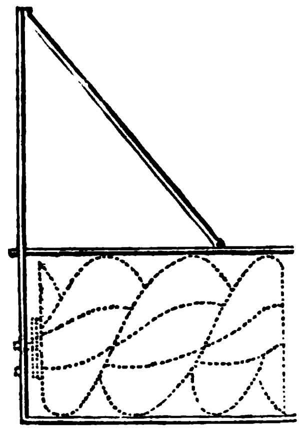


Fig. 7.



Much as we have published on the history of Screw Propelling, we find that the subject is still very far from being exhausted. We are now enabled, through the kindness of our ingenious friend, Mr. Bennet Woodcroft, of Manchester, to lay before our readers a document which carries the invention, *as a patent subject matter*, back to a much earlier date than is assigned to it in popular opinion. It is the copy of the specification of a patent for a screw propeller granted to one William Lyttleton, as far back as the year 1794. Mr. Woodcroft, who, as our readers are aware, is himself an ardent competitor for screw-propelling distinction, (see *Mech. Mag.* vol. xxxix., p. 293) has been led by the interest he takes in the subject to form a *catalogue raisonnée* of all the patents granted for, or relating to propelling, from as early a date as 1618, down to the present time, which he is about to publish; and the "scantling" we now present to our readers may be taken as a specimen of the value and utility of his researches.

Specification.

To all to whom these presents, &c.—I, William Lyttleton, of Mansel-street, Goodman's Fields, in the parish of Saint Mary, Whitechapel, and county of Middlesex, Merchant, send greeting.—Whereas, &c., &c.

Now, know ye, that in compliance with the said proviso, I, the said William Lyttleton, do hereby declare that my said invention of a certain machine, which I call the aquatic propeller, is described in the plan and description thereof hereunto annexed. In witness, &c.

Explanation of fig. 1.—*a a a* represent a hollow cylinder; *b b b* the sweeps fixed at right angles to the cylinder, and on an angle of 35° with the axis; *c c* the pivots of the axis on which it revolves in its frame when used; *d d* is a large sheave with an acute score to prevent the rope from rendering in it when in the act of turning, and has straps for the purpose of fastening it by screws to the inside of the cylinder and the cross bars at the end of it. (See figs. 3 & 4.) 1 1 1, *e e e*, are thin bars with straps (as at *g g*), which being secured to the ends of the cross bars (fig. 3, 2 2 2), and the edges of the sweeps support them in their pressure against the water; *f f f f* are the cross bars (see fig. 3) which are sunk into and secured to the ends of the cylinder; in the centre of them are the pivots *c c*, and the ends being turned and perforated as at 2 2 2, the thin bars (*e* fig. 1) are screwed thereto. The bars being made flattish should stand obliquely or parallel to the sweeps, the ends of which are fastened to them; *r* is part of the endless rope that passes over other sheaves to one at the end of a winch, which is to be turned by men, but may be done far more effectually by means of

a small steam engine. Fig. 2 represents an end view of the propeller with three sweeps.

The number of sweeps should be in proportion to the diameter of the cylinder. Fig. 3 is the cross bars, &c., for three sweeps. Fig. 4 is the sheave for ditto. Fig. 5 represents a skeleton cylinder made of hoops and bars, screwed together, which may (as well as the sweeps) be taken to pieces occasionally.

Note.—The skeleton cylinders are best adapted for use at sea, as they will rise and sink readily with the motion of the vessel.

The frame for the propeller should be adapted to that part of the ship or vessel it is applied at, viz., the sides, or head, or stern.

Fig. 6, a side frame; fig. 7, a head or stern frame.

ON THE WORKING OF STEAM EXPANSIVELY—REPLY TO COMMANDER HOSEASON.

"Ne tentes, aut perfice."

Sir,—It is an old saying, that "an angry man has a bad cause," and from the nature of Mr. Hoseason's reply to the few hasty remarks made by me in No. 1161, it is peculiarly applicable to his case.

I most indignantly deny that I have in any way attacked the "entire members of his profession;" I spoke of the authors of the navy, more especially Otway and himself; and if the mere expression "benighted" can be so widely construed, how small an offence is this compared to the expression of his friend "Binnacle," "that there is a lamentable degree of ignorance prevailing among Royal Navy men on this subject;" added to which, the tender and kind way in which Mr. Hoseason has introduced sundry officers by name, and exposed them as incapable of understanding the most fundamental laws of science; his accusation against the Lieutenant of the *Hydra* (p. 264) of something like falsehood or dissimulation; and lastly, his apology and hope that no ill will ensue from what he has done, are far, very far, beyond anything I have said to the prejudice of those gentlemen, and for whom, as a body, I have too high a respect to indulge in any remarks with regard to them that are not strictly true and correct in fact.

I shall, however, avoid as much as possible this sort of retaliation, and closely adhere to the matter in hand, though I must here remark that my letter barely calls for his uncivil reply—incivility so nearly allied with conceit (which it is always so commendable to put down) that I feel spurred to some little exertion, and trust I shall be able to show your readers that his advocacy of the principle of expansion has been as feeble as his charges against me of "sneering and poking" are purely ridiculous.

Although Mr. Hoseason's letters were originally printed for private circulation only, it was not peculiarly select, and the notoriety which they produced for him in certain quarters appeared to promise some permanent advantages, which we may hope to have been realized. From criticism he was protected, and has remained so, until the recent publication in this Magazine.

That Mr. Hoseason would have exercised a sound discretion in preventing their re-appearance, I am not prepared to deny. Your readers can better estimate mechanical knowledge than those originally addressed.

And what, sir, is really the difference between Mr. Hoseason and myself? I have asked, what does he claim? Has he advanced anything that is *new*, either in the theory or practice of the expansion of steam? His answer is distinctly in the negative; then what can it be but the "reiteration of known principles" that have been practised with such success by engineers for many years past? I have said, if this was his object, he has the undoubted merit of good intentions, and I fully and freely give him credit for any good he may have done.

I have never in the most remote degree denied the benefits to be derived by the expansion of steam; on the contrary I have sedulously laboured for many years past to advance this truth, though in a far different and more efficient way than that practised by Mr. Hoseason, namely, by experiments of all kinds, and by careful indicator manipulation.

To say the truth, the sole advantage this gentleman possesses over some of his brother officers, is that of a tolerable *theoretical* knowledge of the properties of steam; and although I commend him for his application and study, which are unusual, I cannot congratulate him upon

the selection of what he calls facts, brought forward to elucidate his various reasonings; they are simply *not* facts, and there is more or less error in all of them; his want of practical engineering knowledge has led him into many ridiculous fallacies, and he has certainly proved himself incapable of comprehending what he has studied.

I here allude to the "law of the squares" to note that I have not in any way questioned the truth of that law. I am fully content to leave that matter between Mr. Hoseason and the philosophers he has quoted. I have said that the required horse power is as the "*cubes* of the velocities," a law that has been confirmed by a very extensive practice, and before I have done I shall in many instances prove its correctness. I have not misquoted Mr. Hoseason in any way. I merely drew attention to the *fact* that when applying *the* law of the squares to the case of the *Phœnix* (p. 263,) he stated the square of 9 to be *nearly* double that of 7 (!) and as an inference was drawn therefrom, I intended it to show the loose manner in which his "points" are proved, and which is neither Russell's nor Lardner's way of doing such things, but all *his own*.

Mr. Hoseason says, "that he left entirely untouched the question of what horse power ought to be placed in a vessel, in consequence of the increased resistance of the water, as it was not, from the line of argument he had adopted, the subject under discussion, &c., &c." No! He advocates throughout his letters "*the economic use of fuel by the expansion of steam*," and dwells upon the small ratio in which the velocity of the ship, and of course the *power*, decreases with the reduction of a moiety in the consumption of coals. This is his argument, which, though most verbose, contains some truth—some corn, but mixed up with an immoderate quantity of *chaff*. This granted, it does not appear to me what necessity there is for entering at all upon the question of the resistance of fluids as an abstract question. We have to ascertain what is the ratio of the *power or force* necessary to drive a given body through water at a given velocity; and it further appears to me, that must be determined by *experiment alone*, not made upon models in a horse trough, or other convenient place, nor upon one or two vessels, but upon many ships of different forms and scantlings.

When I tell him that the "law of the cubes" has been proved by experiments upon more than 200 steam-vessels of varying forms, weights, and powers, this latter being accurately noted by the indicator, (and which *power* governs and controls all he has argued for,) during a period embracing a practice of 20 years, he ought to be thankful for the information, and certainly courteous enough to withdraw the appellations of "blockhead"* and charlatan, otherwise I must come before you *in propria persona*, and appeal to the profession for their decision as to which of us has the greatest claim to them.

And now a word about the philosophers. I know something of Lardner, and have the honour of personal acquaintance with Russell, but have not disputed anything they have written; that has been done by Mr. Hoseason, who asserts that they differ in their theories; but this I do know, that they have the highest respect for experimental research. If the law of the cubes is not to be found in any of their books, all I can say is, that it *ought* to be, and I shall take the earliest opportunity to bring the matter under the notice of the latter individual.

Mr. Hoseason is disingenuous: I was not so absurd as to credit him with the *discovery* of expansion. I wish to draw the line distinctly where we particularly disagree, and it is this—I say that the whole tone and tenor of his writing would lead a casual or uninformed reader to suppose that he *was in advance of the times* as to the *practical application* of

* I am not so illiberal as to suppose that any one out of the profession cannot, by study and application, soon master the theory of the steam engine; but on the other hand, it must be allowed, that such an individual, be he ever so talented, cannot be expected to match those who have for years devoted their undivided attention to one object. The amateur is crude in his ideas, wanting experience to temper his knowledge. This is illustrated daily. During our last session of the Civil Engineers, one of the most able and talented officers in the navy made an absurd proposition relative to some fitment for her Majesty's vessels. Respect for the veteran alone smothered the cachinnatory movement that was ready to follow. Again, there is that "satisfactory" affair at Chatham, of which you have more than once so good-naturedly spoken, and the letters now under my notice are instances in point. They are all noble fellows, but a little out of their *line*, which should be that of *battle*.

the theory of expansion, a very different thing; whereas I am clearly of opinion, had he never existed, that science, both in its theory and practice, would have been just where it is at present. Perhaps its *practice* would have slightly advanced, because in advocating truth he has mixed up so much that is untrue, and so much that is purely personal, he has produced scepticism where none existed previously.

Mr. Otway's experiments in the *Echo* were right in theory, but failed for the precise reasons given in the previous note. He raised his steam to *one* atmosphere, not *two*, (see p. 124,) and the engine was "fitted with expansion gear." Now, this is what has been done in the private marine for years past, with this slight exception, that the boilers there used occupy (for like powers) just *one-third* the cubic space of those of the *Echo*, with about three-fifths the weight, having the capability of producing double the quantity of steam. If any man's theory states (and I am not aware of anything of the kind) that there is no more economy in the expansion of *high* than in *low* steam, it is undoubtedly wrong. That great controller of all theories, *practice*, is daily giving us proofs of this. The *Great Britain* appears to me particularly a case in point on the one side; she is worked under a pressure of 2½ or 3 lbs. per square inch only, and expanding in the cylinder five-sixths of the whole stroke; therefore if any great economy attended this plan we should have it here.

Allow me to refer Mr. H. to an article of mine on this subject, published in the *Civil Engineer*, vol. 6, page 80, where he will find a detailed table showing what should be the consumption of fuel and speed of that vessel with various powers and expansions. I have only carried the calculation to an expansion of four-sixths of the stroke, but let us take that and he will find that her expenditure per day should be about 34 tons, and her velocity about 9¾ miles per hour. Now, let us turn to this Magazine, No. 1161, page 308. We find that she has really consumed 63½ tons per day! (although expanding five-sixths of the stroke only), which "G. S." states should give upwards of 900 horse power, and is correct, as will be seen by my table, published some months before the *Great Britain* reached the sea. I am by no means prepared to say that this is not caused by matters which have no relation to expansion, but at any rate it is a stronger *fact* than is to be found in Mr. Hoseason's letters.

I have not been able to find any passage in which "working steam expansively with a *high* power in proportion to tonnage," is distinctly expressed and advocated. On the contrary, several of the cases cited, that of *Stromboli*, *Medea*, *Great Liverpool*, &c., have *low* powers in proportion to tonnage, namely, *one* engine, or half the steam used. There is one mention (p. 282) about "*larger* cylinders," which would be useless without *adequate* boiler power, without which, what could be saved? Let the *Great Britain* answer.

And here, sir, we have one of those exploded heresies for which Mr. Hoseason seems so famous—*power has no strict relation to tonnage.* How many vessels are at this moment in existence which have been considerably *increased* in tonnage and in *speed* with a *less* power? I can name at least twenty such of all classes and forms; the *Alecto* might be increased 50, or perhaps 100 tons in burthen, her speed be increased, and in every way made thereby a better man-of-war than at present; and this is no mere fancy, but what every day's practice assures us.

I merely stated a fact in saying it was recently a rule at Woolwich Dockyard, that the maximum safety-valve pressures should be 5 lb. per square inch. I may here add, that I have handled an indicator before such a thing was known in the Government service, and certainly many years before it knew an "Inspector of Steam Machinery;" and more especially still, that I have now before me a book containing upwards of 600 diagrams, taken under every conceivable circumstance of expansion, &c. I have no more occasion to go there for information than to apply to Mr. Hoseason for a lesson on composition.

This rule was certainly no reason why engines should not be fitted with expansion gear; many of them were so, but what was its use? Mr. Hoseason's own testimony assures us it was not likely to be used half an hour!

And what an apology is offered for so restrictive a regulation? "Because a

higher, and therefore *a more advantageous pressure* was deemed objectionable at the period," &c. &c. In the name of all that is reasonable, if this increased pressure was advantageous, how could it be considered objectionable? Oh! Mr. Hoseason, you have yet much to learn as an amateur engineer: for your character and knowledge as a seaman I have a high respect.*

Having now replied to every part of Mr. H.'s letter in No. 1162 that I think worthy of notice, I will turn my attention to the epistles addressed to Sir W. Parker and Sir G. Hammond, all of which, it is said, is not before us. Then, pray let us have it, and if like what we have, it will not be difficult to prove sufficient fallacy, false reasoning and data, to consign it at once to the "tomb of the Capulets;" but in these busy times this must be reserved for another week.

I am, sir, your obedient servant,

PRESSURE NOT PUFF.

November 20, 1845.

ON THE CONSTRUCTION AND USE OF GAS METERS. BY ALEXANDER ANGUS CROLL, ASSOC. INST. C. E.

[From Proceedings of the Institution of Civil Engineers.]

The use of gas, for the purpose of illumination, has now become so general in this country, and involves so much capital in its production and distribution, that any invention, by means of which gas can be more accurately measured than heretofore, becomes of importance.

To honest consumers, an accurate measurement of the quantities used is a direct saving; for gas companies will, for their own protection, establish their scale of contract charges sufficiently high to cover all contingencies. Some idea may be given of the inefficacy of contracts, when it is stated, that warehouses, shops, &c., which were supplied with gas, for the purpose of illumination only, have been heated during the entire day from the ordinary burners, by merely substituting an iron cylinder for a glass chimney around the flame, so as to hide the light, and an inspector from the company might enter, without detecting the fraud. These and other uncertainties in the amount of gas used by the consumers must therefore be met, by a price high enough to remunerate the gas manufacturers, for the largest quantity which they believe may be used, under any circumstances. There is also no doubt, that various devices have been resorted to, by unprincipled consumers, to make their actual consumption appear considerably less than it really was, and thus a large quantity of the gas produced was not accounted for; but the manufacturers were compelled to divide the cost of it among all the consumers, and to make a proportionally high scale of prices. The fair consumer was thus not only made to pay for his own consumption, but to contribute towards that of his dishonest neighbours. The public therefore has an immediate interest in the exact measurement of gas.

But if it be important to the consumers of gas, that it should be accurately measured, how much more must it concern the gas companies! To them the subject is one of extreme interest. It is well known that as much as from 30 to 40 per cent. of the whole quantity of gas produced is sometimes unaccounted for, and this great and positive loss has generally been attributed to leakage. That there is a certain constant amount of leakage through the pores of the metal, of which the mains and pipes are composed, is undeniable. The fact of such leakage is proved, by the saturation of the ground in which the mains are imbedded, though it would appear to have been somewhat hastily assumed, that such saturation would furnish a complete explanation of the whole of the known loss. The erroneous character of this opinion can be readily demonstrated by experiment. The most minute jet of gas can be detected by the smell; for instance, any escape of gas which can scarcely be discovered by its igniting upon the application of fire to the spot, is instantly perceived by the offensive odour. In the author's own house a very small escape of gas took place. This was so offensive, that its continuance would have rendered the room uninhabitable; but when estimated by the meter, it was found to be only one per cent. Further, escapes of gas in the streets have been detected by the smell, which when traced, were found to be incredibly small, when the nuisance they had occasioned was taken into consideration. These facts show, that it is impossible to account for even 5 per cent., instead of upwards of 30 per cent., of the ascertained loss, which is the utmost allowance to be made for loss from bad joints and porous metal in the mains.

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* In my letter published in Number 1161, I committed an absurd error, and the most has been made of it. I stated the power of the *Phœnix* at 110 horses. I gave one engine only, as the diameter of cylinder and length of the stroke prove; but the *ratios* are the same with any power. I meant to show, that if a *given power* propelled that vessel 9 knots, *half* that power would produce 7·18 knots.

Practical observations, made in the performance of his professional duties, as superintendent of gas-works, have convinced the author, independently of theory, that such an amount of leakage is impossible; for if even 5 per cent. of loss really occurred in that way, the streets, through which the gas passed, would be absolutely intolerable.

The amount of gass daily distributed from the works of the Chartered Gas Company alone may be taken at about 2,703,000 cubic feet; the loss of 30 per cent. upon that quantity would occasion 810,000 cubic feet of caburetted hydrogen to be set free daily in a comparatively limited district of the streets of London. It may be objected, that the gas escaping in the soil becomes decomposed, and that therefore no smell is observed; but this hypothesis is inadmissible, as in that case, the hydrogen would be formed into water, and the carbon would be deposited in the soil; therefore the quantity, by weight, annually left in the soil, from the supposed escape of 30 per cent., would be upwards of 3,000 tons.

This is from the works of one company only; and if we consider the enormous additional quantity that would be produced from the other ten metropolitan companies, we cannot avoid pronouncing it to be utterly impossible.

In the course of a tour of inspection made recently, through some of the principal gas-works of Manchester and Scotland, the author found, that there was in fact very little, if any practical loss of gas; but that it was nearly all accounted for. Almost all that was made by the companies being conveyed to, and paid for, by the consumers.

There was, however, both in Manchester and Scotland, the same appearance of saturation in the ground, through which the mains passed, as in London. The metal of which those mains was composed was identical, and yet the Manchester and Scotch companies were paid for fully 25 per cent. of gas which in London was totally unaccounted for, and was wasted. It could not be doubted, that this advantage was obtained, by the whole of the gas being consumed by meter, under a judicious system of inspection. It must therefore be concluded, that the great loss of gas in London may be attributed to surreptitious consumption.

The author's experience has furnished him with numerous instances, in which persons have been detected in the use of contrivances, to consume more gas than their meters indicated. In one case, a publican was suspected of some proceeding of this kind; but the gas company's inspectors could never detect anything wrong. The meter, which was placed in a cellar, always indicated an extremely small consumption, and the publican was anxious to explain the exertions which he continually made to economise gas. Still the officers were not satisfied; but whenever they went to the premises, they could never obtain immediate admission to inspect the meter. There was always some special reason why they should call again in an hour, or the next day, though at their regular and anticipated quarterly visits none of these delays took place. An observation satisfied them, that more gas was consumed on the premises than was accounted for. At last, by stratagem, the inspector obtained admission to the cellar without any previous notice, and he found that the pipes had been unscrewed from the meter, and were connected together by means of a straight tube, and thus about two-thirds of the estimated consumption for that house was an absolute loss to the company. This case was the more remarkable, on account of the consumer being a leading member of a society for the prevention of fraud. In other cases either a bladder was used, or what was termed "a jerry," passed behind the meter, to connect the service-pipe with the fittings, without any communication with the meter.

The ordinary wet meter is necessarily placed in the basement, in order to receive the water which, rising as vapour out of the meter, is condensed in the fittings. The meter is therefore almost always in a dark cellar or an obscure corner, and in some instances fraudulent methods have actually been in existence without detection, during the inspection of the company's officers.

The extent to which these practices have been discovered, and the facilities which are afforded to the dishonest portion of the community, for rendering the water meter ineffectual, together with the excess of consumption by the contract consumers, leaves no doubt that they prevail so widely as fully to account for the whole loss, hitherto attributed to leakage.

It will be obvious, that by the method of measuring gas by wet meters, placed in dark cellars and obscure corners, the gas companies must depend upon the vigilance of their inspectors, to an extent which is neither wholesome for the servant, nor secure for the employer. The introduction of a good meter has become therefore extremely desirable, and that which is the joint invention of Mr. Richards and the author, will, it is believed, prove a remedy for many of the evils which have been complained of. It can be placed in any position, even in the most conspicuous situations, and admits of precautions and checks, by which all surreptitious consumption of gas may entirely be

prevented. The inspectors of the gas companies may thus obtain an exact knowledge of the consumption for each house, and the great saving effected, by bringing the extra quantity, of more than 30 per cent. of gas, into the estimate, will enable the manufacturers to lower their prices with profit to themselves, which will extend and increase the use of their production.

It is well known that the water meter, invented by Clegg, and improved by Crossley, is substantially the same as that now generally in use. It is ingeniously constructed for measuring gas, and with proper inspection, in the hands of honest people, and of those who do not understand the art of disarranging its water level, it is a sufficiently accurate instrument. But there are the numerous difficulties, before alluded to, in the way of complete inspection, and unfortunately there are too many persons who understand the methods of rendering this meter inoperative, and who do not scruple to adopt such means of defrauding the manufacturers of gas.

The action of the water gas-meter is generally understood. The gas is introduced at a central opening of the measuring drum, which is sealed with water; the pressure is exerted upon the surface of the water, and the diagonal divisions of the revolving wheel, which is the measuring chamber of the water-meter. The revolutions of the wheel, caused by the passing of the gas, are shown by the index. Now the effect of this meter can be easily evaded by various methods. The correctness of its measurement depends entirely upon the water in the meter being kept at the proper height; thus, for instance, if the case of the meter be tilted forward to an angle of from 5° to 13° (according to its construction), and a proportion of the water drawn off, so as to unseal the outlet of the measuring chamber, the gas passes through it without affecting the index, and without being registered at all. This is constantly done, and to an extent of which gas companies are little aware. Whenever the practice has been detected, the parties defrauding have attributed it to accident, and unfortunately the companies have no means of proving the design of thus surreptitiously obtaining gas.

During the winter, the water contained in the wet meter is sometimes frozen; and then it is necessary, in order to enable the gas to pass through to the fittings, that the meter should be removed. The bad example of avoiding the measurement of the gas, until a fresh meter can be substituted, is thus set by the company itself. The number of new meters required on such occasions is so great, that a considerable period often elapses, before the frozen meter can be replaced.

To meet these admitted evils, various kinds of dry meters have been at different times invented; but hitherto they have been open to such serious objections as to prevent the general adoption of them in practice. The first machine of any importance was that of the Dry Meter Company. The material of which the measuring chamber of that meter was formed, was leather, which has been found liable to several objections. If the meter is used only occasionally, at intervals, the action of the gas upon the leather produces considerable contraction, and causes a registration of an increased proportion against the consumer. On the other hand, when the meter is in constant use, the leather is expanded, whereby more gas passes into consumption, than is marked by the index. This of course operated unfairly against the manufacturer of gas. Then the facilities it also afforded to the fraudulent, and the perpetual sudden changing of the valve to and fro, in its opening and collapsing, producing an unsteady flame, created a prejudice against its use, wherever a clear and steady light was required. These imperfections have therefore rendered this meter obsolete.

The next dry meter was introduced by Sullivan; although of a different construction, it was formed upon the same principles, of the same material, and was subject to precisely the same evils as regarded the leather and the unsteadiness. This meter likewise never came into general use.

The only other dry meter of sufficient importance to be mentioned, is that constructed by Defries. In this instrument, each of the three measuring chambers of which it is composed is separated from the others by a flexible partition formed of leather, partially defended from the chemical action of the gas by metal plates. This flexible partition is expanded by the pressure of the gas, and in the alternate expansion and contraction it forms a cone. Now as a cone is one-third part of a cube, one-third part of the surface only is available to the pressure of the gas. Independently of the loss of power thus occasioned, a further loss arises from the sides of the flexible partition being fixed, and the centre only being moveable, and registering by its motion the gas consumed. Further, if where the leather is attached to the sides of the case, there be a play of $\frac{1}{16}$th of an inch between the plates and the line of attachment of the leather, in the backward and forward motion, it passes through $\frac{1}{8}$th of an inch; thus, when by use and exposure to the atmospheric air the leather has contracted only $\frac{1}{32}$nd of an inch, then in its motion it passes through this $\frac{1}{16}$th part of an inch, the effect of which is, that the measuring chamber is diminished by this $\frac{1}{16}$th of an inch,

over the whole diaphragm. Now since it measures merely a conical space, it must be evident that this loss of $\frac{1}{16}$th of an inch over its surface very much lessens the measuring chamber.

In cases where the meter has been some time at work, it is stated, that it has thus registered, against the consumer, as much as from 8 to 11 per cent. The reverse of this occurs when the meter has been some time in use, without any admission of air, and then the manufacturer incurs a loss.

Each flexible partition consists of four triangular divisions, each of which is protected by a metal plate and between each division and all round the outer rim of the partition, where it is attached to the case of the meter, there is necessarily an uncovered surface of the leather, to allow the partition to move freely backwards and forwards, this leather is consequently liable to be acted upon by the gas.

This circumstance must be an objection to every meter, in which the flexible material forms part of the measuring diaphragm.

Croll and Richards' meter avoids these objections, which have hitherto prevented the general use of dry meters. The machine will be more readily understood, by imagining a steam engine measuring its steam, as it really does, in all cases. The steam enters the cylinder, from the boiler, on the top of the piston, forcing it through a certain space; the supply is cut off, and the action is reversed, the bulk of steam occupying the space through which the piston moves, is thus measured; for presuming the piston to be of a given area, and the distance through which it moves at every stroke, to be constant, it can readily be conceived how the actual quantity of steam employed could be indicated or calculated. The meter in question bears a strong resemblance to a double engine. It consists of a cylinder divided by a plate in the centre into two separate cylindrical compartments, which are closed at the opposite ends by metal discs; these metal discs serve the purpose of pistons, and they are kept in their places by a kind of universal joint, adapted to each; the space through which the discs move, and consequently the means of measurement, is governed by metal arms and rods, which space, when once adjusted, cannot vary. To avoid the friction attending a piston working in a cylinder, a band of leather is attached, which acts as a hinge and folds with the motion of the disc; this band is not instrumental, to any extent, in the measuring, so that if it were to contract or expand, the registering of the meter would not be affected, inasmuch as it would only decrease or increase the capacity of the hinge, the disc still being at liberty to move through the required space; the leather is also distributed in such a manner, being curved, and bending only in one direction, that it prevents any wrinkles or creases from forming, and renders it, therefore, much more durable.

The arrangements of the valves and arms are somewhat different to that of a steam-engine, although similar in principle.

Another advantage of this meter is the small amount of pressure which is required to work it.

This valuable quality can be best appreciated by practical gas manufacturers.

By means of this meter the gas companies possess an accurate measure of the quantities of gas actually consumed by each of their customers, and their inspectors have no longer to contend with the difficulties and the frauds above enumerated.

Mr. Croll explained, that the chief peculiarity of this meter consisted in the disc moving bodily forward, without having any portion of the periphery limited in its action by a hinge. The band of leather surrounding the disc, might be compared to the packing of the piston of a steam-engine, and any expansion or contraction that might take place, could not alter the capacity of the measuring chamber, or change the distance travelled by the disc. The leather was not liable to crack, as it was not worked backwards and forwards, but was always bent in the same direction. He considered this was an important improvement, as in almost all other dry meters, the flexible material acted as the hinge, at the same time that it formed part of the measuring chamber. He found, practically, that the action of the meter was very steady and that the measurement was accurate. About eleven hundred of these meters were now in use, although they had only been manufactured for the last nine months.

Mr. Defries said, there were some points of Mr. Croll's paper, with which he could not accord, although he perfectly agreed in the statement of the general deficiencies of the wet meters, and the facilities they afforded for fraud. Being aware of the objections against all meters with only two compartments, as being liable to cause oscillations of the lights, he had, in the construction of his meter, adopted three chambers, in order that its action, like that of a three-throw pump, might be continuous. In practice this was found to be the case, and at the Thames Tunnel, the House of Lords, and in many private establishments, where very large meters, made by him, were used, and their measurements were tested daily, none of the contraction, or expansion, of the

leather hinges, or any alteration in the size of the chambers, had occurred. The leather used, was prepared expressly for the purpose, and he believed, that the theoretical objections, both to the use of leather hinges, and to the form of the chambers, were not well-founded; at all events, no ill effects had been found to result from either in a period of seven years, during which time, upwards of ten thousand meters had been made. He contended it must be evident, from the form and the arrangement of the chambers of his meter, that it would work correctly under a low pressure; indeed at less, he thought, than if the disc moved bodily forward; but that point could only be ascertained by actual comparative experiments.

Mr. Stevens had used all the kinds of meters extensively, and he certainly preferred that of Mr. Croll, with whose observations he accorded, relative to the wet meters, and he was of opinion, that it was desirable to obtain a meter that should not be subject to any variation in the dimensions of the chambers, to which, he apprehended, all of them would be to a certain extent liable while leather was used for any part.

Mr. J. Farey knew Mr. Clegg's wet meter well, and thought the principle on which it was constructed was so perfect, that it would be difficult for any dry meter to supersede it, provided the cases of wilful fraud were guarded against. All measuring instruments required care, and he apprehended, that the new meter would be in some degree liable to the objection of being tampered with, which had been urged against the wet meter. He thought the most serious objection to the wet meter, was its liability to freeze and to become useless in the winter.

The meter with three chambers, appeared at first view, most likely to keep up an equal flow of gas, and he did not think the dimensions of the chambers would be subject to alter, so as materially to affect the capacity.

The meters with two chambers, were somewhat on the principle of the diaphragm pump, patented by Benjamin Martin, nearly a century ago, but which did not succeed in water. The same kind of pump was more extensively used for the "Carcel" lamps, and in oil it was very durable; but he was of opinion, that when working in dry gas, the leather diaphragm would crack, unless it was prepared in a peculiar manner to resist this tendency.

Captain W. S. Moorsom said, that a point of much interest connected with the subject, was the leakage of the gas through the metal pipes. He understood the same effect had been observed, on the atmospheric railway, where the leakage through that portion of the main which was composed of close pipes, was as great in proportion as in that part with the continuous valve.

Mr. J. T. Cooper said, there could not be any doubt of the porosity of the ordinary metal pipes, so that the process of "endosmose and exosmose" occurred to a great extent, particularly with soft iron pipes. This subject had been discussed at length last session.* If harder iron, of a greater density, were used, there would be less porosity. He was astonished to hear the statement, relative to the leakage of the air through the metal of the pipes, in the main of the atmospheric railway; but with respect to the pipes in the streets, it was not surprising, that carburetted hydrogen gas, which was very volatile, should traverse the pores of soft iron.

The method of exhibiting the "endosmose and exosmose" process, by means of jars, covered with a sheet of India rubber, and filled with gases of various density, was well known to chemical students.

Mr. Farey believed that if the gas pipes were made from better materials, they would not be so porous as to be in any way prejudicial; but now, for the sake of a low price, they were cast from any sort of coarse bad iron, and they could scarcely be expected to be sound. Much also depended upon the method of casting them. If they were cast in moulds placed vertically, with fountain jets, the thickness of the pipes would be more uniform, and the metal would be less liable to be spongy.

Mr. Lowe was of opinion, that Mr. Croll had estimated at too low a rate, the amount of leakage of gass from the station, the mains and the service pipes. He was aware of the difficulty of arriving at a correct estimate of the loss, from the different parts of so comprehensive a system as the lighting of a district; but he was anxious to remove any impression of the Gas Companies' sanctioning any attempt at incorrect measurement of the gas delivered for consumption, and he thought also, that although some flagrant cases of fraud, on the part of the consumer, had been detected, there was some little exaggeration in Mr. Croll's statement of the extent of such practices. Mr. Lowe was aware, that in some places extraordinary results were announced. For instance, at Rothesay, Isle of Bute, the engineer said, that he could account for every foot of gas that was made. He did not even allow the loss of 5 per cent., which it was generally admitted, not unfrequently leaked

* *Vide* "Minutes of Proceedings," 1844, vol. iii. p. 307.

away, by the defective joints of old gasometers. No allowance was made for the condensation in the mains, of the aqueous vapour, and other matter carried over by the gas, and which constantly occurred in all pipes.

Mr. Lowe had made a careful examination of this point in a main of pipes, 18 inches in diameter and nearly a mile in length, which was laid from the Horseferry-road gas station to the Houses of Parliament, for the express purpose of lighting those buildings alone. At first it was observed, by the difference between the meter at the works and that at the House of Lords, that there was a leakage of about 150 feet per hour; there was not any perceptible smell at the surface of the ground, but when the pipes were laid bare, it was discovered that they had been badly laid and that there were many defective joints. The whole line was repaired and was apparently perfect, but still there was a certain amount of leakage.

The same had been observed in the independent main from the gas works to the Penitentiary. During the daytime, when no gas was used, and the pressure was only $\frac{8}{10}$ths inch, just to keep the main filled, the meter on the main at the gas works never stood still, but eventually indicated a certain amount of loss, which could only be the result of leakage from the pipes.

Another source of loss, was that which arose from the destruction of the wrought-iron service pipes, by oxydation under ground. It had been asserted, that in opening the ground in the streets, it was not uncommon to find, that the whole of the metal of the service pipe was gone, and that the gas travelled through a tube of metallic oxyde, which had formed a sort of concrete, with the gravel in which the tube had been laid. Many kinds of artificial coating had been tried for protecting the service pipes from the action of the damp earth, but Mr. Lowe believed, that hitherto nothing effectual had been discovered. The wrought iron service pipes would, at present, last from three years to five years, after which new ones should be laid down. He was convinced, that more than 5 per cent. should be allowed for the leakage of the main alone, independent of all those other sources of loss which he had enumerated.

Mr. Lowe did not think, that any of the meters registered with mathematical accuracy, the quantity of gas passing through them: but he was of opinion, that if the water line of the wet meter was correctly maintained, that meter, in its actual improved state, was the most accurate. In very hot, or very cold situations, dry meters were essential, as the evaporation of the water, or its freezing, would equally derange its action. The freezing could be obviated by dissolving in the water a little common salt, or some caustic potash (soaper's lees); but the evaporation could not be prevented.

He thought, that when in good order, the dry meters would work under as light a pressure as the wet meters; but there was a possibility of the leather becoming rigid, if they remained any length of time inactive.

The ratio of the amount of the leakage did not appear to follow the same rule, with respect to the diameter of the pipe, as did the quantity of gas passing along pipes of given diameters, under given pressures.

Mr. Croll did not think Mr. Lowe's arguments conclusive, against the position assumed in the paper. The case of the Rothesay gas works had not, alone, been considered, as many gas works accounted for within 8 per cent., of all that was sent out. The Manchester works had a deficiency of only $3\frac{1}{2}$ per cent. In a main of very large pipes, extending from the gas works situated at West Bromwich, to Birmingham, a distance of nearly seven miles, the amount of leakage was only from 7 to 8 per cent. The gas was sent along the main, under a pressure of about $3\frac{6}{10}$ inches, until it reached Birmingham, which was about 120 feet higher level than the works at West Bromwich. About 16,000 cubic feet of gas passed through the main per hour.

Mr. Croll exhibited the discs and leather packing of his meter, detached from the case, and explained, that from the manner in which the leather was attached to the discs, whatever expansion or contraction occurred, no alteration could take place in the quantity of gas expelled by each forward motion of the disc; for the packing formed a bag all round, in which a certain quantity of gas lay stagnant, and whether that bulk was greater or less, no difference could be produced in the measurement.

Mr. Farey thought the rigidity of the leather would very probably impede the action of the dry meter, and that the unexpressed gas which remained in the bag, or packing, would probably become more dense, and thus more inequality of measurement would ensue. The wet meter was free from these objections.

Mr. Apsley Pellatt was a considerable consumer of gas, and he must be allowed to give his testimony in favour of the dry meters; he found, that in consequence of inattention to the water line in the wet meter, errors of measurement had repeatedly occurred, and constant annoyance had been experienced from their being frozen in water; but since he had adopted the dry meter, a saving of nearly 15 per cent. had resulted.

THE CONDENSED STEAM-VACUUM PRINCIPLE, PROVED TO BE THE ORIGINAL PATENT OF MR. S. CARSON, IN OPPOSITION TO THE CLAIMS OF MR. MALLETT AND MR. NASMYTH. BY HENRY DIRCKS, ESQ.

At a time when the railway world is agitated with schemes of every mechanical variety for one kind or other of railway improvements, and the directories of the numerous lately projected companies have one system of propulsion after another offered to their notice as the safest, most economical and expeditious, it becomes an important duty to examine with care and settle with exactness the claims of those inventors whose plans offer the most reasonable prospect of ultimate success. The atmospheric principle of propulsion has afforded many interesting practical results in opposition to the preconceived opinions of not a few eminent railway engineers; first, as evidenced at Wormwood Scrubbs, where Messrs. Samuda's first experimental line of road was laid down; afterwards in the extension of the Dublin and Kingstown Railway, at Dalkey; and more recently at Croydon. The only great drawback to this principle appeared to arise from the unavoidable expense of producing the required vacuum by powerful stationary steam engines at comparatively short intervals. When Mr. James Nasmyth's patent for a steam-vacuum (sealed October 22, 1844,) was announced, his distinguished character as a most inventive and intelligent engineer, naturally contributed to raise expectation, that a principle at once so simple and economical as that proposed by him would, if anything could effect the object, prove the salvation of the atmospheric principle of railway propulsion. Instead of costly engines, and air-pumping machinery, the entire labour of obtaining the vacuum in the propulsion tube was to be performed by a communication with two or more vertical cylindrical boilers, or vessels of like construction; high pressure steam entering at one end was to blow out at the other the contained air, without employing any piston—for Mr. Nasmyth found the steam and air did not intermingle, at least not to any detrimental degree—and by means of a suitable condenser, using a pipe, or rose, a jet of cold water could be thrown in as formerly introduced for the old atmospheric steam engines. Then by opening suitable valves, the air rushing into these vacuous cylinders would exhaust the propulsion tube on the line of railway. Every one who heard of this mode of applying the condensed steam-vacuum principle, unhesitatingly avowed its excellent adaptation for the intended purpose.

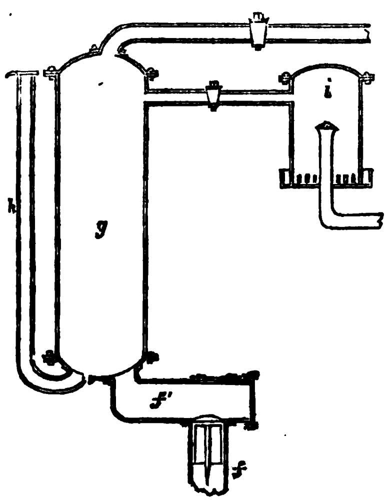
It would be singular if an invention so apparently obvious to any practical mechanic should escape being anticipated, and we can scarcely be surprised, therefore, in this instance to find it the case; a curious instance being afforded by the published papers of Robert Mallett, Esq., A.B., Memb. Inst. C.E., M.R.I.A., &c., which appeared in Mr. Weale's Quarterly Papers on Engineering, containing three communications by this gentleman, "Upon Improved Methods of Constructing and Working Atmospheric Railways." They bear date Nov. 15, 1842, and will be found in the *Mechanics' Magazine* from 20th Sept. to 4th October last. It seems Mr. Mallett was consulted by parties interested, in reference to the subject of improving the means of obtaining the vacuum for use upon atmospheric railways, the latter part of the year 1842; and having first communicated his ideas, confidentially, to one party, he afterwards drew up a Memoir, sealed it, and deposited it in the Archives of the Royal Irish Academy, on the 13th of November, 1843, (one year after its composition,) Mr. Nasmyth's patent being specified the latter end of April, 1845. Mr. Mallett no sooner became acquainted with its purport, than at an early meeting of the Academy, on the 20th of May, 1845, he had his sealed packet opened in their presence, when it was found to contain three MSS., which it is presumed are those already alluded to as being since published. The inventions certainly appear identical, and so far, a remarkable coincidence is established. Mr. Nasmyth, in his patent represents two vacuum cylinders placed vertically; Mr. Mallett shows four placed horizontally; but in principle both are dependant on blowing out the air by the direct action of high pressure steam, and condensation afterwards, as Mr. Mallett says, by "water supplied to the condenser by a *perforated* pipe and stop valve." The only extraordinary part of the matter is, that Mr. Mallett should assert his priority in reference to Mr. Nasmyth, when

the latter had actually specified a patent claim, and which became *public* property nearly a month before anything was heard of Mr. Mallett's secreted memoirs; yet he speaks of them as being "*published* prior to the date of his (Mr. N.'s) patent"!

However, I am now prepared to show, that neither of these esteemed and talented engineers has any just claim to priority of application of this, as Mr. Mallett designates it, "generation and condensation of steam in close vessels of suitable capacity."

On February 5, 1840, a patent was granted to Mr. Samuel Carson, for *improvements in apparatus for withdrawing air or vapour.* Mr. Carson's object was to produce currents of air, either by a blast of air or steam; or by a vacuum produced by the condensation of steam. He describes various modes, some applicable to chimney tops, others to flues, others to the shafts of mines, and for *other purposes.*

It will here suffice to state, that in his specification the following diagram is given as figure 8.



and the patentee describes it as showing "another apparatus, constructed according to my invention, and is to be *worked by a vacuum produced by the condensation of steam; f,* is a shaft or pipe, in connection with a mine or house, *or other place, from which it is desired to withdraw air.* On the upper part is applied a valve opening upwards; *g,* is a vessel into which the pipe f^1 enters; consequently any air which passes from the pipe way *f,* will flow through f^1, into the vessel *g,* and when *steam is admitted into the vessel g, the air therein will be driven out at the opening and valves, h.* The vessel is supplied with two pipes, one by which steam is allowed to flow into the vessel, *g. I prefer to use high pressure steam,* and to cut it off at such a position that in expanding it will fill the vessel, *g,* with atmospheric steam; *but I do not confine myself thereto.*

"The other two pipes lead to a condenser, *i,* and there are stop-cocks on the steam pipe, and the pipe which leads to the condenser, which cocks are to be alternately opened and shut. Thus, supposing steam had been allowed to flow into the vessel, *g,* and was closed, the cock on the pipe leading to the condenser, *i,* would be opened, by which the steam would rush away and be condensed, and there would be a vacuum produced in the vessel, *g,* but that the valve on the passage opens, and air flows into and fills the vessel, *g*; the cock on the pipe to the condenser, *i,* would then be closed, and the cock on the steam pipe would be opened, by which steam would again flow into the vessel, *g, and drive out the air therefrom by the air valve.* And by this arrangement *a very cheap apparatus for using steam as a means of withdrawing air will be obtained.*" And in conclusion, he says, "I claim the mode of constructing apparatus *to be worked by steam and condensation,* as described in respect to figure 8." This specification was enrolled 5th August, 1840.

A more complete proof than this cannot be offered of the nullity of Messrs. Nasmyth and May's patent, or of the unsubstantiality of Mr. Mallett's claims, although his opinions are supported by Mr. Bergin, Dr. Robison, Ast. Royal, Armagh, Dr. Apjohn, T.C.D., and equally unquestionable authorities, their evidence in favour of this economic mode of effecting a rapid and complete vacuum, only affording most satisfactory evidence of Mr. Carson's just views, and the talent and ingenuity he has displayed.

Had Mr. Carson confined his patent claim to a particular object, which he has not done, then indeed Mr. Nasmyth would still be entitled to the application

for railway purposes; but fortunately for the original patentee, neither in the title of his patent, nor yet in his specification, does he restrict himself, but expressly claims this admirable mode of superseding the use of the air-pump, for purposes enumerated, or for "*other places from which it is desired to withdraw air.*" On the other hand, Messrs. Nasmyth and May claim for the express object of applying this system to atmospheric railways,* a claim to which Mr. Carson has a clearly prior title.

While on this subject, it may be interesting to notice that the storing of a vacuum, but obtained by an air-pump, in three, or more cylindrical vessels or boilers, forms a part of the patent claims of Mr. Henry Bessemer, engineer, in his patent for *improvements in the manufacture of certain glass*, which was sealed 23rd September, 1841, and published in the *Mechanics' Magazine* for 30th July, 1842.

In thus plainly stating facts, I am far from being actuated by motives of hostility or favouritism, my only desire being to assert the rights of inventors, particularly in a case like the present, when claimants appear who not only are *not* the original inventors, but who are taking much pains to fix priority in a matter which I have thus shown to be totally unworthy the contest.

Mr. Carson's patent is published in *The Repertory of Patent Inventions, N. S.*, vol. xv., 1841, and therefore it is somewhat remarkable that both Mr. Mallett and Mr. Nasmyth should act, the one by his writings, the other by his procuring a patent for this previously patented invention, as though entirely unacquainted with a patent so recent, and one, which in regard to the important object it proposes to attain, amazingly simple and efficacious.

7, Nicholas-lane, City, November 22, 1845.

FRICTION OF WATER IN PASSING THROUGH LEATHERN HOSE.—REPLY TO "A FIREMAN'S" NOTES. BY MR. BADDELEY.

"Hear the just law—the judgment of the skies!
He that hates truth shall be the dupe of lies;
And he that *will* be cheated, to the last,
Delusions strong as hell shall bind him fast."
COWPER.

Sir,—The publication in your pages of an abstract of Mr. Braidwood's paper "On the means of rendering large supplies of water available in cases of fire, &c.," (vol. 42, p. 137,) containing as it did, some novel doctrines on matters of considerable moment, led to my penning the "Strictures," which appeared in the subsequent numbers of your Magazine (Nos. 1130, 1131, 1133.) These strictures have been met by an anonymous writer, who, under the assumed signature of "A Fireman," affects to get rid of my objections in a very summary manner, without bringing to the task much either of good sense or good feeling.

Had the writer of the "Notes" confined himself to the temperate discussion of the plain matters of fact and of science controverted by my "Strictures," I should have felt much pleasure in arguing the disputed points. Not content with this, however, "A Fireman" indulges in the grossest personalities, imputes motives, and adopts a vituperative style of argument that clearly shows the animus by which *he* is actuated.

Such conduct, and such language, from an anonymous correspondent towards a well-known writer, and one of your oldest contributors, has procured for me the most gratifying assurances of esteem from many of your constant readers.

Passing by, therefore, as I can well afford to do, the Augean filth of personalities, I shall address myself at once to the vindication of the opinions I have hazarded respecting certain scientific facts, as opposed to the opinions of Mr. Braidwood; the present paper will be devoted to a subject of considerable importance, and one upon which it is highly desirable correct notions should prevail, viz., the friction of water in passing through leathern hose.

Mr. Braidwood has stated that the loss by friction amounts to five per cent. for every 40ft. length of hose that is employed, (not 2½ per cent. as misrepresented by "A Fireman.") Mr. Braidwood's words are, "the loss by friction in the leathern hose *reduces the delivery*, and of course the height or force of the jet, 2½ per cent. for every 40 lineal feet of hose through which the water passes," (vol. xlii. p. 137,) and "the friction *increases the labour* 2½ per cent. for every additional 40ft. of hose." (Ibid. p. 139.) To this proposition I have objected, that the experiments upon which the foregoing hypothesis was based were not to be relied upon, being neither sufficiently

* See *Repertory of Patent Inventions*, No. 6, vol. v., 1845.

numerous, nor conducted with sufficient care, to afford data whereupon to found any practical conclusions. I showed, also, that the experiments, as recorded, were so contradictory and inconsistent in themselves, that it was impossible to attach any value to their results; and expressed my belief, that no sufficient data as yet existed for determining, with any degree of certainty, the real amount of loss by friction in forcing water through leathern hose. I denied that the friction was at any time (as assumed by Mr. Braidwood) a constant or uniform quantity, and enumerated a few of the numerous causes which inevitably occasion variable results.

Without attempting either to reconcile or explain away the inconsistencies of which I complained in Mr. Braidwood's table of experiments, "A Fireman" merely affirms them to be entitled to the greatest reliance, and to show upon what grounds he thinks they are so, he furnishes an authentic copy of some more recent experiments corroborative (as he supposes) of the former ones. Had these tables been furnished, or the experiments conducted by myself, they might have been regarded with suspicion, confirming as they do, in a very remarkable manner, the opinions I have advanced upon the subject. Coming from the other side, however, they may be regarded as entitled to reliance. It is much to be regretted, that with Mr. Braidwood's appliances and means to boot, the experiments should have been limited to only 10 lengths of hose; however, referring your readers to the details of the experiments as given at page 56 of the present vol., I will just place the terminal results of the three sets of experiments in a tabular form, to show your readers at a glance their bearing upon the question at issue:—

Lengths of Leather Hose.	Pressure in feet.	Delivery in gallons per minute.	Loss per cent. for each 40 ft. length.
10 = 400 ft.	38	53	2·4
10 = 400 ft.	103	80	2·3
10 = 400 ft.	120	84	1·6

The details of these experiments prove (if they *prove* anything) that the friction *is in no case uniform*. That the friction *does not* increase either 5 or 2½ per cent. for every 40 lineal feet of leathern hose. And that the friction decreases as the pressure and velocity increases. The ratio of increase in the friction under diminished pressure is very remarkable, and would lead us strongly to suspect the presence of some disturbing element which had escaped the experimenter's ken. It will be seen, that in one case an increase of 65 feet in the pressure diminishes the friction but 0·1 per cent., while, in another experiment, an increase of only 17 feet in the pressure actually diminishes the friction 0·7 per cent.! Will "A Fireman" throw any light upon these singular phenomena, or explain away the inconsistencies I have pointed out? At any rate, your readers will require something more than the assurances of an anonymous writer, that such experiments are "entitled to great reliance."

One of the most striking elements of incongruity in the first experiments (the height of the jet) has been carefully omitted in the more recent ones; but, taken as a whole, they are nearly, if not quite as inconsistent, certainly quite as unsatisfactory as the former ones.

Mr. Braidwood's theory of a uniform friction of 5 per cent. per length, so far from being demonstrated, is completely negatived by his own experiments. "A Fireman" says, (p. 55,) "the hose *may* be of such a length, and the friction consequently so great, that there *would* be a total loss or absorption of the forcing power employed." Now, I beg to say there is nothing "startling" to me in this proposition; on the contrary, I hold it to be indisputably true. The only question is, *what length* of leathern hose will it require to accomplish this absorption? According to Mr. Braidwood's

theory of a uniform loss of 5 per cent. per length, 20 lengths of hose would absorb the working power; or, if 2½ per cent., 40 lengths would do it. But the whole of Mr. Braidwood's last experiments go to show a continually decreasing ratio of friction for every length that is added, so that, if hose enough be employed the friction will at last be—*nothing!*

Now, I beg to state positively, as the result of actual experiment with a brigade size engine, (7 inch barrels,) that 40 lengths of hose will *not* absorb the whole of the forcing power; on the contrary, with 40 lengths of hose attached, and only a small number of hands on the engine, a very considerable forcing power has been available for throwing a jet of water. "A Fireman" objects to my pressing the principles of Mr. Braidwood's theory to their natural and inevitable conclusion, but I hold this to be a legitimate and logical mode of exposing their absurdity.

If two engines, exactly alike in every particular, and equipped with the same size hose and nose-pipes, but the one having one length of hose affixed, and the other twenty, are worked at the *same speed*, and consequently deliver the *same quantity* of water, the two jets will not rise to the same height, although the initial velocity of the water is the same in both cases. In the one case there would be a greater absorption of power, because, with the twenty lengths of hose, the men would have to exert more force to maintain the same speed as the others, and we should have a diminution in the height of the jet, but no reduction in the delivery! Will "A Fireman" please to explain this circumstance, or reconcile it with any of the experiments on which he places so much reliance?

The "loss by friction" of water passing through leathern hose has, from Mr. Braidwood's exposition, become a sort of bugbear that has in some recent instances, to which I need not more particularly allude, been productive of considerable mischief. There can hardly be two opinions about the propriety of working engines upon a fire through as short a length of hose as is consistent with a perfect command of the fire, and the safety of those who work the engine; but neither of these important matters need be compromised, nor parties deterred from carrying or using long lengths of hose, from fear of all the forcing power being "absorbed by friction."

I remain, Sir, yours respectfully,

WM. BADDELEY.

29, Alfred-street, Islington,
Nov. 11th, 1845.

THE LIVERPOOL FIRE POLICE AND LONDON FIRE BRIGADE.

Sir,—When in Liverpool, a few weeks since, I paid a visit to the head station of the fire police in that town, and much gratification it afforded me, through the kindness and attention of the superintendent, Mr. Hewitt. I assure you, sir, that the good men of Liverpool beat their London brethren hollow, not only in the power, but in the management of their magnificent engines; and I can therefore set my seal to the truth of what Mr. Baddeley says in their favour. Depend upon it the 7 inch squirts of our London fire brigade, whose inefficiency at such disastrous fires as those at Fenning's wharf in 1836, and Topping's wharf in 1843, one would think ought to have been sufficient to seal their doom, will never be abolished until the *protection of the lives and property of the inhabitants of this metropolis is taken from the insurance companies, and consigned to the care of the municipal authorities alone.* I noticed that each of the Liverpool engines is provided with a long reel, on the top, around which is wound a great quantity of hose, with the branch screwed on the end, and ready for immediate use. The importance of this ingenious plan is readily estimated by those who have witnessed the time lost by the London firemen on their arrival at a fire, by having first to undo several lengths of hose strapped together, and then, unite them until the requisite length is obtained. That anxious exciting work, p[illegible] paring an engine for immediate [illegible] should rightly occupy but a few mom[illegible] yet, although this plan has been [illegible] adopted in Liverpool and elsewhere, [illegible] sapient London firemen cannot or [illegible] not admit its utility. None of [illegible] engines belonging to the Liverpool [illegible] police have less than 10 inch barrels, [illegible] are capable of throwing jets to the he[illegible]

of about 115 feet. What Mr. Braidwood has written respecting the unmanageableness and loss of power in working engines of this class is all a delusion, for constant experience fully proves the contrary, and I am sure he can never have witnessed a Liverpool fire, or he would not have made such a rash assertion. Surely he is again grossly in error in supposing that the duties of a police and fireman can never be efficiently performed by the same individual, as in Liverpool. All I can say is, that I think our metropolis would be rendered somewhat safer were experienced firemen on duty in its streets day and night, and that it would not be much more difficult to make the police understand firemen's duties now than it was in 1832 to get the old-fashioned firemen and novices into habits and modes of action they never before were used to or understood, as Mr. Braidwood did on taking the helm of the London fire engine establishment. I have long read Mr. Baddeley's intelligent communications in the *Mechanics' Magazine* with great interest, and I consider the public is deeply indebted to one who has laboured so long to render the fire engine and its appurtenances as perfect as human means can. May the day speedily arrive when he may meet with reward, and not neglect, as now, and when the motto of all fire-extinguishing bodies will be "Utility and humanity."

I remain, yours truly,

D. J.

ON THE CONSTRUCTION OF STEAM VESSELS, SIDE WHEELS, AND SUBMERGED PROPELLERS. BY J. H. WARD, LIEUT. U.S.N.

[From "Elementary Course of Instruction on Ordnance and Gunnery; together with a Concise Treatise on Steam, adapted especially to the use of those engaged in Steam Navigation." By the Author.]*

Construction of Steamers.

1. The first consideration in constructing steamers, is to obtain in them the least proportional resistance to the displacement that is consistent with the strength and stability requisite for the service they are to perform. If this service regards only speed under steam alone, and is to be performed in smooth water, the proportional resistance may be rendered very small by giving great length as compared with the beam or breadth. In this manner the displacement may be doubled without increasing resistance—but on the contrary, a reduced resistance may be produced by rendering the water lines "easier;" that is, by reducing the angles with which the vessel enters and leaves the water. In the construction of steamers for smooth water, there is scarcely any limit to the application of this principle, except steering in crooked channels, and turning in comparatively narrow places.

2. But these excessively long vessels are objectionable as steamers on the ocean, because the enormous weight of the engines and boilers being concentrated within a small space near the centre of the vessel, when the two extremities are sustained by the tops of two waves, and the centre of the vessel is partially forsaken by the trough of the sea, the centre will settle, and occasion leaks, unless the vessel is constructed with an extraordinary degree of strength, which must be proportioned to her length.

Again, if a very long vessel, heading a heavy sea, be raised at the bow by a wave, and that wave passes under her to the centre, sustaining that part, the bow will overhang the wave and drop, opening the butts of the planks, and occasioning strain and leak.

3. The kind and degree of strength necessary to prevent the extremities, and the centre of a long steamer, alternately settling in the manner described, are given to a vessel chiefly by her side planks. If her sides are deep, so that this planking has great breadth, the vessel will be correspondingly strong,—otherwise weak. Several long river boats with no great depth of sides, have broken at sea and foundered.*

4. The capacity of a steamer to carry fuel, power, &c., is as her displacement. Her resistance, to which this power must be proportioned, is as the area of her greatest immersed cross section. But as vessels increase in dimensions, their forms being similar, the capacity increases as the cube of any given dimension; and the area of the immersed section, or the resistance, increases only as the square of that dimension. Hence, increasing the size of a vessel

* The work from which we give this extract was prepared for the use of the midshipmen at the Naval School, Philadelphia. It is a very clever and useful production, and superior to anything of the sort which we have in this country.—Ed. M. M.

* In respect to long iron steamers intended for sea, care should be observed in their construction to guard against the possibility of their breaking. The securities necessary are indicated by the effect which will occur, if a tin or sheet iron model, having a great weight placed in the centre, is suspended by the extremities. One long iron sea steamer has broken and foundered for want of this strength.

so as to double her resistance, and double the cost of running her by doubling the quantity of fuel consumed in a given time, *more* than doubles her capacity to carry freight, fuel, &c., which explains why large vessels of any kind are found most profitable where there is employment enough for them, and why large steamers can keep the sea longer, and accomplish longer voyages with the fuel they are capable of carrying, than smaller steamers.

Let there be taken, for example, two vessels, one 30 feet wide, 150 feet long, and drawing 10 feet water; and another 40 feet wide, 200 long, and also drawing 10 feet. The displacement (or capacity to carry) of one is represented by 45,000, the product of the three measurements; and the displacement of the other by 96,000. The relative resistances are represented by 300 and 400 —that is, the capacity of the larger vessel is more than 100 per cent. greater than the smaller, and her resistance, and consequently her power and expense, are greater by only 33 per cent.

5. The difficulty of ensuring to single-decked vessels of very great length, such as the *President* and the *British Queen*, strength enough, even with deep sides, to prevent their breaking and foundering, constitutes an objection to the excessive increase of size, and prescribes a limit to the practical application of the principle explained in the preceding article.

6. In proportioning engines to vessels intended for steaming only, it is customary to allow a horse power for every two or four tons—giving the highest proportion of power to smallest vessels for reasons explained in Art. 4.—There is a growing partiality for high proportional power, especially for vessels engaged in the transportation of passengers. And for steamers of war it is argued with plausibility, that in their power to obtain great speed, lies an essential portion of efficiency.

7. But experience as well as figures has abundantly proved, that no private capital nor public treasury can bear the expensive drain produced by constant steaming, in any number of vessels performing ordinary mercantile voyages on the ocean, or employed as cruising men-of-war. Neither is it ordinarily possible to sustain the expense, in cases where steam is the principal power, and sails the auxiliary. Experience has, however, further shown, that in many, if not in nearly all cases, mercantile navigation can be rendered more certain and profitable, and the service of men-of-war more certain and efficient, by retaining the sails as the principal power, and introducing steam as an auxiliary; modifying the forms of vessels somewhat, so as to preserve the adaptation to sails, and yet yield something to the new auxiliary power introduced.

8. The forms of vessels intended entirely for steaming are wholly different from those intended for lofty sails. The forward lines of the steamer are made sharp; for if they were full, the propelling power being applied near the water, by division of forces, the water striking obliquely under the bow, would lift the bow and settle the stern. On the other hand, if those lines in a sail vessel were made sharp, the propelling power being applied at a lofty point on the masts, would serve to pry the bow under, or bury the bow. But this burying tendency is counteracted by the full forward lines of sailing vessels.

Vessels intended for both sails and steam are in these respects a compromise; but it is evident that the full lines which will fit them for sailing, renders them incapable of great speed under steam alone, unless loaded with an enormous weight of boilers, engine, and fuel, which would leave neither space nor capacity to carry anything else. Therefore, we conclude that power calculated to give great speed can rarely be applied wisely or profitably to vessels intended also to possess essential sailing qualities and capabilities, except in the case of vessels of war, which might with advantage have great power in reserve, to be used only in emergencies.

Side Wheels.

9. For vessels which are constructed and intended to be propelled by steam alone, and in smooth water, no other plan affords the same advantages as side wheels. These wheels are usually on the extremities of a single shaft extending across the vessel from side to side. For convenience of room in river or passage boats, however, or for the sake of having a second engine to rely upon in case of accident to either in sea steamers, the power is frequently divided in two engines. In such cases, sometimes instead of both wheels being on one shaft, and both engines connected to that shaft, each wheel has its independent shaft, and each engine drives a single wheel only. The advantage of this latter plan for river boats and harbour steamers, is that they are turned quicker and in a shorter space, because one wheel may turn forward and the other back.

In sea steamers, the wheels must be on a single shaft, and both engines connected to that shaft; for if by the ship's heeling one wheel is thrown out of water, it offers no resistance to the rapid and dangerous motion of the piston; but the other wheel, by being

buried deeper, compensates for this want of resistance.

10. With side wheels, sails and steam are rarely or never employed in conjunction with advantage, because, if the wind is on the side, sails heel the vessel more, bury the lee wheel, and lift the weather one; under which circumstances, both act disadvantageously, and produce less speed, or certainly no more than would result from the sails alone, or from steam alone. The case before the wind might not be much if any better. With a fair wind, therefore, a ship may go equally fast with sails alone, or steam alone, or with sails and steam in conjunction. But if sails are used, the steam cannot be dispensed with, unless the wheels are "disconnected," so that they shall afford no obstruction to the progress of the vessel whilst the engines are at rest.

11. There are two methods practised of disconnecting. One is to unstrap the connecting rod from the crank pin, and let the crank and wheel revolve independently of the engine; the other is to take off a third of the paddle boards from the arms of the wheel, and confine the wheels with the naked arms in the water, which present a very small obstruction. To perform either of these operations, it is necessary perfectly to confine the wheels by ropes and chains, which, when there is a sea on, it is difficult or impossible to accomplish.

This difficulty of disconnecting a side wheel, or of connecting again at pleasure in an emergency in any weather, is the principal obstruction to the introduction of steam power as an auxiliary on board sailing vessels. Persons feeling the uncertainty of being able to reconnect, hesitate to disconnect, and therefore employ steam, at great expense of fuel, when, but for this difficulty and uncertainty, they would more frequently employ sails, and obtain equal or superior speed. If side paddles are adhered to in sailing ships, some arrangement, strong, simple, and easy of adjustment for connecting and disconnecting the wheels and engines, is indispensable, and invites the ingenuity of those engaged in the mechanic arts.

Submerged Propellers.

12. A principal advantage of submerged propellers, is, that their paddles being beneath the action of the sea, are with ease disconnected, even in the roughest weather; and the uncertainty existing in that respect with side wheels is obviated. Consequently vessels fitted with propellers may sail more and steam less,—steaming only in head winds, calms, or emergencies.

Another advantage which submerged propellers present in ocean navigation is, that they are not thrown out of water by heel of the vessel under canvas; and therefore, with them, both sails and steam may act in conjunction, with great advantage and economy.

13. In favour of the propellers it may be further urged, that they are not affected by the more or less deeply laden state of a vessel with coal, which, when leaving port, dips side wheels so much that power is lost, and on arriving at port dips them so lightly as to produce also from that cause great loss of power. Also that they are protected from shot and other dangers at the surface.

Against the propellers it may be urged, that they are inacessible for repairs, in case of derangement, without going into docks, which are rarely at hand. A loss of power is generally attributed to them, as compared with side wheels in smooth water. Possibly propellers now in use may be rendered accessible by devices that will obviate the necessity of docking; and other arrangements may be presented, free from these objections. At all events, it may safely be predicted that steam navigation will soon become common on the ocean, as auxiliary to sails, and that this result will be accomplished by means of propellers, and propellers only.

LAWS OF FALLING BODIES.

Sir,—Your correspondent, Mr. Davison, whose communication on the laws of falling bodies you have printed in No. 1162, has fallen into some curious mistakes, which he will, perhaps, be obliged to me for pointing out.

1. He says, "We are at liberty to institute a comparison between the sagittæ of two arcs described in the same time without any regard to their size," &c.

This is not the case. The sagittæ are only measures of the central forces when the arcs are so small that the *direction* and *magnitude* of the forces may be considered as constant during the time of describing the arcs.

2. He seems to make a double mistake as to the meaning of the law of the equable description of areas, for he applies it to compare the periods of revolution of *two* bodies describing *different orbits*, when the law only applies to the times of the *same* body describing *different portions* of its orbit. He also seems to confound *areas* with *arcs*, for he says that the proportion of the area A E C to the area A B C, when S E is diminished,

becomes ultimately as A C to A B C; whereas, in truth, the area A E C becomes ultimately infinitely small; and his reasoning ought to have led him to the absurd result that a body descending to a centre of force in a right line would reach the centre in an infinitely short space of time.

3. Mr. Davison is, of course, right, in saying that if the force of projection is less than that in a circle, the body projected will describe an ellipse which will fall within the circle, but both his figure and his reasoning assume that the centre of force will be in the *centre* of the ellipse, whereas it will be in the further *focus;* and when the force of projection becomes very small, the body will descend nearly in a straight line to the centre, and turn sharp round and re-ascend to its original position.

4. The mistake just mentioned is the occasion of Mr. Davison's making the further mistake of supposing that according to Newton's theory the time of falling to the centre from a given distance is *one-fourth* of the periodic time of a body moving in a circle at the *same* distance; whereas it is obviously *one-half* the periodic time of a body describing a circle at *one-half* the distance, which time or less than the other in the proportion of 1 to $\sqrt{2}$

5. Mr. Davison makes another mistake, in supposing that "by mechanics a body descending from any height will go over the same space in half the time with the velocity acquired at the end of the fall." This is only true where the force that acts is *constant*, not where it varies with the position of the falling body, as would be the case with a body falling from the moon to the earth.

Mr. Davison appears, and most laudably, no doubt, to have endeavoured to obtain some knowledge of the results of Newton's theory applied to the motions of the planets, without having the opportunity or the ability to make himself master of the means by which these results are obtained. If such be the case he will, I think, find in the article "Gravitation," in the Penny Cyclopædia, written by the Astronomer Royal, and also published separately, an explanation of the mode of action of gravity which an acute personl but who has not the use of mathematica, tools, may probably understand and apply with less chance of falling into gross blunders than the theorems of the Prin cipia.

Your obedient servant,
A Barrister.

THE PLANET MARS.

We have lately had our attention invit to the singular appearance now worn b the planet Mars. Hitherto, this planet h been distinguished by a fiery redness of co lour; which, to use the language of S John Herschell, "indicates an ochrey tin in the general soil, like what the red san stone districts of the earth may possib offer to the inhabitants of Mars." Such i however, no longer the case; that plan having lost all appearance of redness, an put on a brilliant white aspect, vying in ap parent magnitude and brightness with th planet Jupiter itself. The only change which have heretofore been noticed in Mar are those, the knowledge of which was de rived from observations with the large reflect ing telescopes of Herschell. These tele scopes exhibit the appearance of brillia white spots at the poles; which spots, fro the circumstance of their always becomi visible in winter, and disappearing as th poles advanced towards their summer posi tion, have reasonably been attributed to th presence of snow. The novel appearanc now described to us, however, by the Hon Company's astronomer, Mr. Taylor, is suc as that the whole of the planet, with the ex ception of a moderately broad equatori belt, assumes a decidedly white aspec strongly contrasting with what he has ev before noticed. We look forward with gr anxiety and interest to those observations the above planet which may be expected have been made, through the medium of th numerous and powerful telescopes now work in Europe. Lord Rosse's magnific telescope will likewise (we venture to ho have been perfected, so as to allow of bringing it to bear upon the celestial bo apparently undergoing the remarkable cha discerned by Mr. Taylor; and, for the be nefit of those who do not enjoy the opp tunity of looking through any large powerful instrument, we confidently tr that the labours of the artist and engra will be put in requisition, with a view making them acquainted with these won of the heavens.—*Madras Spectator.*

THE "SATISFACTORY" JANUS.

Chatham, Nov.

"The *Janus* steam sloop has again turned to her former moorings by the

hulk, opposite to the dockyard, having been towed up on Friday, the 21st inst., by the *Wildfire* steam vessel, she having broken down at sea. This unfortunate vessel, it appears, left Cockham-wood Reach at twelve o'clock at noon, on Wednesday, the 18th inst., as reported, for Portsmouth, whereas she was to take a cruise in the Channel, having on board Captain W. H. Shirreff, R.N., Captain Superintendent of her Majesty's yard, accompanied by Vice-Admiral the Earl of Dundonald, the constructor of her engines, and manned by the seamen of the ordinary; and reached Sheerness in about two hours and a half, the paddle wheels revolving about thirteen times to the minute, and on her arrival outside the river, touching the sea-water, her pace became slackened, and it gradually decreased, and on her arrival near the Mouse, her speed was so reduced that her wheels only made eleven revolutions in the minute, although she had a strong wind in her favour, and, in attempting to turn her, she drifted astern; consequently it was found necessary to anchor her for the night, as it was rough, and blew a strong gale. The next morning the engineers could not get the wheels to turn until noon, when they revolved about five times to the minute, and at which rate the engines continued working until eight o'clock at night. The next morning (Thursday), the weather being fine, it was attempted to run the vessel over to the Downs, but it was found that, by using every exertion, she would not make head against the sea. Further trial was therefore deemed useless, and the vessel was put up again for Sheerness; and on her arrival in the river water she returned to her former speed. On passing her Majesty's vessel *Trafalgar*, however, her engines broke down, and she was obliged to anchor for the night; and on Friday she was towed to this port. On raising her anchor it struck her bow, and made a hole in it. It is now clear that this vessel, according to her present construction, will never go a-head, having now failed in a hundred experiments, and having had all the resources of Chatham-yard lavishly expended on her for the last year, without the least improvement. Her engine is stated to be very defective. The rotary engine of this vessel, it appears, is fitted with four tubular boilers, equal in bulk and expenditure of fuel to 500-horse power boilers, and with engines estimated at 200-horse power, but withal, the boilers have never worked up to 60-horse power. The boilers are divided into two sets, with a stokehole between them, which forms a kind of pandemonium, where the unfortunate firemen are scorched by six furnaces on each side of them, and by the cylinders full of steam above their heads, while their feet and ankles are immersed in hot water, and where they are deprived alike of air and light. It is stated that this machinery is not fitted with the appendages which experience has shown to be essential to the safety of a steam-vessel, because they cannot be attached to a rotary engine without extraordinary complication. Yet, notwithstanding these omissions, it occupies 38 feet fore and aft, and great part of the upper deck; while a perfect pair of engines of 200-horse power, with tubular boilers, and every appendage for safety and convenience complete, with ample airy stokehole, and free access to every part, would not occupy more than 34 feet.

"During all the expensive experiments on this unfortunate craft not the least improvement has been made. With wheels proportioned to her nominal power, she would not make two miles an hour, and when sent to sea in this instance she did not make headway against a light sea, whereas another vessel would have run full speed.

"The *Janus*, on going out, had only forty tons of coals and four tuns of water on board. She is now two feet lighter than she was during her first trips, and has one and a half-streak of her copper painted black, to make her appear deep in the water. Her engines, since her arrival, are being taken to pieces."—*Times Correspondent.*

To the Editor of the "Times."

Sir,—The various short paragraphs respecting the *Janus* and her engines which have found their way to the public through your widely-circulated paper, having appeared to me to proceed from uninformed persons, I have abstained from troubling you to correct errors; but perceiving that nearly half a column has this day been devoted to the subject, and that an insidious misrepresentation has been transmitted to you, which may impose on the public, I claim of your justice a space sufficient to rectify erroneous assertions, and to place the forbearance of the Admiralty, wisely shown towards the developement of a machine (peculiarly adapted to actuate the screw propeller) free from exposure to derangement by shot, which is of the highest importance to the naval service.

I am, Sir, your obedient servant,

DUNDONALD.

8, *Chesterfield-street, Nov.* 26.

Memoranda, being Facts relative to the Progress and Performance of the Revolving Engine on the Principle of those in her Majesty's Sloop *Janus.*

The Earl of Minto, when First Lord of the Admiralty, having learned from his bro-

ther, Rear-Admiral Elliott, that rotatory engines had been successfully used (in two small steam-boats), and that their compactness, levity, and celerity of motion rendered that kind of engine peculiarly suited to the naval service, ordered a trial to be made of the power of a condensing engine on that principle by pumping water from a well in Portsmouth Dockyard.

This engine had been at work for full twelve months when the present Admiralty made their first official visit to that yard, and their Lordships had an opportunity of witnessing the energy and power it then displayed, which, by constant work, has now increased to such a degree, that not one of the thirteen engines in the yard (most of which are on Watt's principle) has produced a better vacuum, or required less repair, as is testified by Mr. Taplin, the chief engineer and mechanist of that yard.

This result was not, however, obtained without great anxiety and trouble. Thirty times at least within 18 months of its erection was this engine taken to pieces, and at times parts of it were sent to London to be altered, under the impression that some defect or other prevented its efficient performance. Such, indeed, was the prejudice originally existing, augmented by repeated failures to work the engine, that it was on the point of being finally rejected by the authorities, when it occurred that perhaps the cold water pipe leading to the condenser might be choked. Admiral Sir Edward Codrington, Rear Admiral Bouverie, Captain Sir Thomas Hastings, Mr. Taplin, and Mr. Blake, the master shipbuilder, were present to witness the result of, perhaps, the last trial; and they and others saw the injection-pipe cut, and a plug of wood withdrawn, which blocked the passage, so that not one-fourth of the water required could enter the condenser; indeed, after the pipe was re-joined on the following day, the engine could scarcely work two of the three pumps it was destined to put in motion; it was therefore again pulled to pieces, and also the air pump (which had never before been suspected as a cause of obstruction); nevertheless it was found that the delivery valve was not only open, but was retained open by its cover being screwed down upon it, thereby effectually preventing the formation of a vacuum, even by the most free introduction of injection water, and the most complete condensation.

It may here be noticed that a ball of rope yarn and a hank of strands were subsequently extracted from the injection-pipe; and that within the last two months, on examining the lower valve water-pumps at the bottom of the well, in the middle suction-pipe a plug of solid elm wood was found, which completely blocked up that pump, and consequently during five years and a half defeated the trial of the engine by the pumping of water. In confirmation of this, Mr. Taplin says, in a note dated the 18th of September,—"The plug must have been there from the time the pumps were first put in motion. As a proof of this, we never had such a supply of water as at present."

It need, therefore, be no matter of surprise if the large engines of the *Janus* have been delayed in the performance of their duty, or that numerous trials failed to produce a satisfactory result. On Saturday, the 15th, however, the engines started well, and were accelerating, when the wedges of the clutches of the paddle-wheels (being slackly driven) slipped, and the engine flew round and broke the chain of the air-pump, which being repaired on Monday, the *Janus* proceeded down the Medway purposely at a moderate rate, in order to ascertain if any damage had been done to the engines themselves by the accident of Saturday. There being no visible indication of derangement, the vessel proceeded, and was anchored near the Mouse Light at dusk, on account of the difficulty of passing through the shoals at night. On the following morning, on setting the engines to work, no vacuum could be formed in one engine, which having thrown the whole labour on the other, it soon became manifest that some partial derangement had taken place therein; and a search having been made, it was discovered that one of the snift valves had been misplaced since the preceding evening; consequently the atmospheric air had thereby free access to the condenser. This impediment having been detected and removed, it was further discovered that the end plate of the air-pump (lately withdrawn for inspection) had been improperly jointed, so as to suspend its useful action. Every person conversant with the mechanism of engines will fully understand how totally independent these impediments are of the principle of the engine, yet how fatal to its operation; which I have no doubt, like the Portsmouth engine, will be rendered perfectly efficient. Indeed, the brief specimen exhibited on Saturday confirms this opinion, having accelerated from 18 to upwards of 20 revolutions before the accident.

With regard to the boilers of the *Janus*, it is hereby fearlessly asserted, that having been first tested by authority of the Admiralty, under the immediate inspection of the officers of Chatham-yard, and the great superior evaporative power having been doubted, an application was made to the Admiralty to direct the engineer department of Woolwich Dockyard to test the boilers. By

result was that their power amounted to 314 cubic feet of water evaporated per hour, at the economical rate of 12·9 pounds, by each pound of Llangenneck coal—a result testified by the engineer's official report of the trial, now in the records of the Admiralty, dated the 19th of last November; the importance of which result, in a maritime point of view, every person acquainted with steam navigation is competent to appreciate. Lastly, in regard to the temperature of the "stoke-hole," although the furnaces are opposite, it may be truly asserted, that the temperature is less than at the same distance from any tubular boilers in her Majesty's service.

DUNDONALD.

UNDERHAY'S PATENT IMPROVEMENTS IN VALVES AND TAPS.

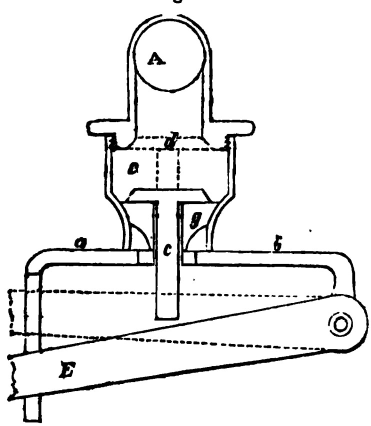
[Patent dated 3rd May, 1845; Specification enrolled Nov. 3, 1845.]

The present patent comprehends *first*, certain improvements in ball valve cocks, and *second*, a new description of valves, to which the inventor gives the name of "cam valves."

The common ball-cock, as all practical men are well aware, is extremely liable to get out of order, either through turning hard or leaking. The water-way, through the barrel and key of the *square way cocks* (as they are technically termed) is contracted to about one-third the area of the pipe; when those again with *round* or *full water-ways* are used, the barrel and key are necessarily much increased in size, and a larger and heavier ball is required to open and shut them. Another objection to the latter is, that they close or open the passage very slowly, the ball having of course to describe the fourth part of a circle, (the radius being the length of the ball and rod.) Many attempts have been made to overcome these objections, but hitherto with doubtful success. Mr. Underhay's plan for the purpose is represented in the following figure; it is simple and ingenious, and appears to us likely to act most effectively.

A is the elbow-piece of the supply-pipe, through which the water or other fluid is to flow into a vessel to a height to be regulated by the rise of the ball or float B (not shown in the figure.) C is a valve-box which is screwed on to the end of the supply-pipe A, and terminates at bottom in a bearing-piece D, having two dependent arms of unequal length, *a b*.

Fig. 1.



The lever E of the ball B is passed through a slot in the long arm *a*, of the valve-box, and secured at its extreme end in an open cleft in the short arm *b*, by means of a cross pin *c*, which passes through the cheeks of the cleft and the interposed end of the lever, and on which pin the lever turns freely. The length of the slot in the arm *a* determines, of course, the range of action allowed to the lever E; F is the valve, which consists of a portion of a metallic cone *c*, which fits into a conical recess *d*, in the mouth of the elbow-piece A of the supply-pipe; and *e* is the spindle, which passes down through a pipe *f*, supported by a cross-bearing, *g*, in the centre of the valve-box C. As long as the water or other fluid is at so low a level as not to act on and raise the ball, the spindle of the valve rests on the lever E, as shown in fig. 1, and the water or other fluid flows freely in all around; but as soon as the rise of the water raises the ball, it raises in a like degree the lever attached to the ball, and with it the spindle of the valve F; and so the action continues till the lever E attains a position exactly parallel with the valve F, (as indicated by the dotted lines in fig. 1,) and that valve closes the mouth of the supply-pipe, and prevents the ingress of any more water or other fluid. And by an inverse course of action, as soon as the water or other fluid begins to fall below the required height, and the ball or float to fall along with it, an opening is made for a fresh supply.

It will be observed of this ball, 1st,—

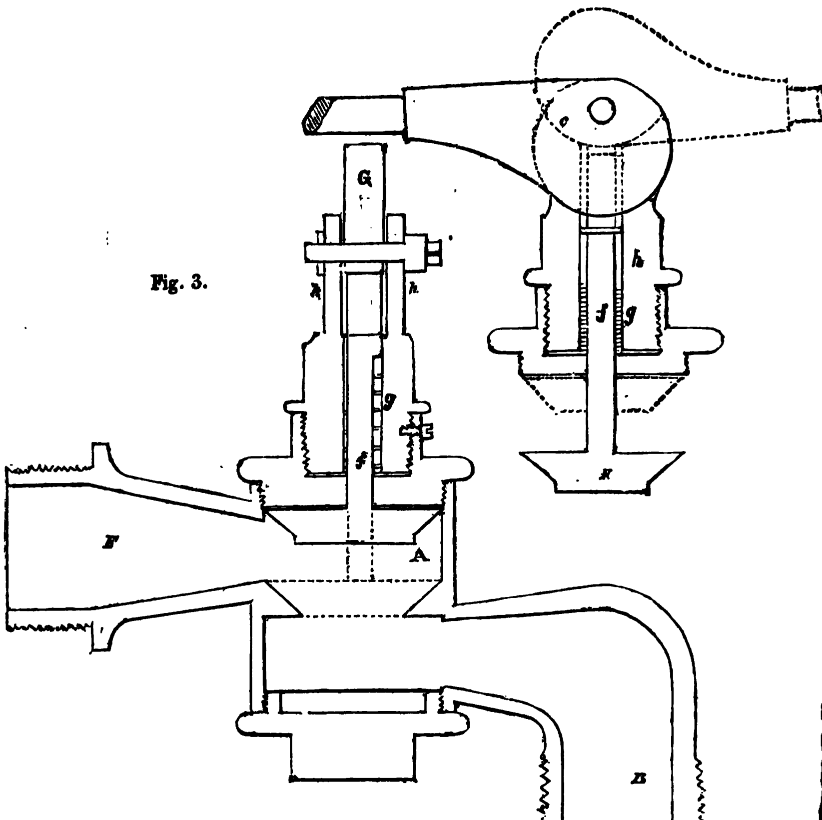
that the ball having to travel through a very small space, the water must flow freely through the aperture or opening, which must in all cases be equal to the area of the supply-pipe itself.

And 2ndly,—that as the ball descends, the valve opens downwards, wherefore the pressure of water on the surface of the valve must always act efficiently for the purpose. The ball moving freely on a pin, without any appreciable amount of friction, because of its superior buoyancy, has greater power to close the valve, when the level of the water in the cistern or tank has risen to the required height.

The new CAM-VALVE COCK is represented in the subjoined figures.

Fig. 2.

Fig. 3.



A is the valve-box; B the inlet pipe; E the outlet pipe; F the valve; *f* the spindle which works freely up and down through a stuffing-box in the top of the valve-box; *g* is a spring which is coiled round the spindle. G is the cam handle which turns on an axis, which is immediately over the top end of the spindle and supported by the two cheeks *h h*. In the view, fig. 3, the handle is represented as in a horizontal position, the valve and spindle as up, and the inlet and outlet passages as open. The view, fig. 2, shows how by the turning round of the cam handle the spindle is pressed down, and the passages closed.

Fig. 4 (a side view, and fig. 5, an end view) represent a modification of the cam valve in which the handle is made to act as a double lever, both to raise and to depress the valve spindle. The

Fig. 4.

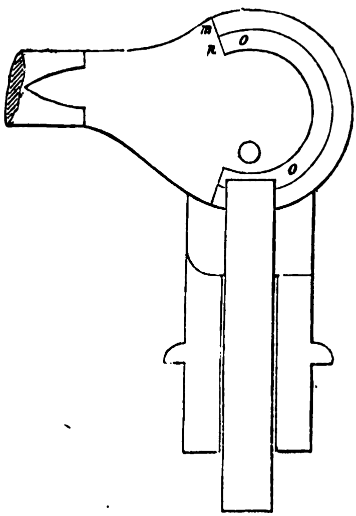


Fig. 5.

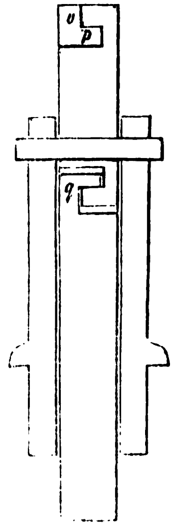


Fig. 6.

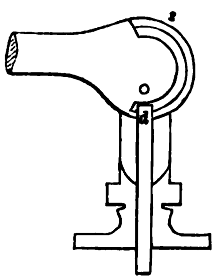
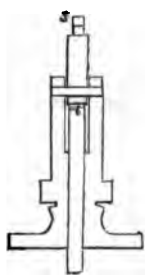


Fig. 7.



cam is cut away on one side from *m* to *n*, as shown, and a groove, *o o*, then made in the diminished side. The top end of the valve spindle has a cleft, *p*, made in it, into which the larger or undiminished side of the cam fits, and the upper side of that cleft, *q*, is reduced to the size of a pin, just large enough to move freely in the groove, *o o*, of the cam. When the cam handle is turned backwards from the position in which it is shown in fig. 4, the cam acting against the top of the valve spindle depresses it, and when turned in the opposite direction it raises the piston by acting upwards against the pin, *q*.

Figure 6 (a side view,) and fig. 7 (an end view,) represent a modification of the arrangement shown in figures 4 and 5. In this case, the cam is cut away on both sides, and through to the extent shown, and an arched piece, *s*, left standing out from the centre of the cam (viewed endwise,) with an open space between it and the body of the cam. The valve spindle has a cleft made in the upper end of it, the two cheeks of which carry a cross pin, *t*. The arched piece *s*, of the cam, is inserted in this cleft behind the cross pin, *t*, so that when the cam handle is brought forward from the position in which it is shown in figures 6 and 7, the body of the cam acts on the valve spindle to press

it down, and when turned the other way the pressure of the arched piece against the crofs pin, *t*, raises the piston.

The advantages of these cam-valves are, firstly—a considerable saving in metal, and consequently in first cost.

Secondly,—Their non-liability to derangement, by the barrel being cut, or the plug wearing unequally, which is always the case, especially when hot liquors are used, the key and barrel in such cases being unequally expanded by the heat.

Thirdly,—The largest valve-tap is easily opened and shut, without friction, and with little power exerted. The action of the cam is simple and certain in its effect. The valve is forced into its place in one-half a revolution, when the cam is in a horizontal position; and the valve and seat being the point of contact, the spindle of the valve has to move through a very small space compared with the cam, thus causing a close adhesion, by contact of the metal, and acting with very great power.

The stool-cock in common use, is open to even more serious objections than the ball and other cocks before alluded to. Leakage is very frequent, and the damage to walls, floors, and ceilings, is considerable. A *valve*-stool cock on the plan just described, cannot leak, either at the top or bottom, and being fitted with leathern washers, by merely unscrewing the metal cap, a new washer may at any time be put on without expense. All that is required to open the valve, is a slight pressure downwards of the handle; by removing the pressure, and withdrawing the hand, the valve closes immediately of itself.

For gauge-cocks in steam-boilers, this cam movement is admirably adapted. In using high pressure steam, it is very difficult to get ordinary gauge-cocks to stand; they soon get *cut* by the steam and water, and are rendered useless. Underhay's valve-gauge-cocks, on the contrary, would last for years, without breaking or cutting.

We have much pleasure in directing the attention of builders, plumbers, engineers, and others interested in the subject, to these simple, useful, and efficient contrivances, which we think cannot fail, ere long, to supersede the taps and cocks at present in general use.

STATISTICS OF THE HOSIERY MANUFACTURE BY MACHINERY IN THE UNITED KINGDOM, COMPILED FROM ACTUAL CENSUS TAKEN IN 1844. BY WM. FELKIN, NOTTINGHAM.

[From Minutes of Evidence taken before the Commissioners appointed to enquire into the Condition of the Frame Work Knitters.]

Before the time of Queen Elizabeth, stockings were usually knitted of very coarse woollen thread, or, if desired to be cool and elegant, they were cut out of linen, and sometimes even of silk tissue. Elizabeth wore hosen of cloth of silk, stitched after having been shaped by the scissors. It was during her reign, in A.D. 1589, that the Rev. W. Lee, M.A., a clergyman then living at Woodborough, in the county of Nottingham, invented the stocking-frame. It was brought about in this wise. Finding the lady to whom he was attached always more attentive to her knitting than to his addresses, in grief and anger he determined to supersede her employment, by inventing an engine which should be so much more speedy and effective as to make it altogether useless. He met with difficulties so great in the complexity and nicety of adjustment requisite in the machine to be made, and so unlike anything that in the then state of mechanical knowledge had ever been seen or thought of, that his own want of experimental and practical science meeting with no aids from the skill or experience of others, he was long greatly baffled, and almost in despair. At length he succeeded, and his queen smiled in person on his discovery. She visited him accompanied by her minister, at his lodgings, saw him work his frame, and accepted from him stockings, woven by this machine, for her own use.

So great were the expectations formed of profit, that her kinsman, Sir William Carey, afterwards Lord Hunsdon, wishing to participate by learning the art, bound himself to Lee by covenant; and in his person, a descendant of the Tudors became the first stocking-weaver's apprentice. But these flattering prospects did not continue; and after seeing his great, but politic patroness, laid in her grave, and waiting long to see if her successor would encourage him to keep the invention at home, the continued neglect of the court of James drove him to accept the offers of the French minister, Sully. Ther too, he was flattered and disappointed. Aft establishing the manufacture at Rouen, th king was murdered, the minister disgrace and Lee died after 22 years of deferred hop an alien, almost an outcast, of a brok heart. Lee's brother returning to Englan brought his frames to London, where for ag stockings were very extensively wrough The Frame-work Knitters' Company st

survives; but is as useless as it is powerless for any trade purposes. Its arms are the stocking-loom supported by a clergyman, and a female presenting her unused knitting skewer or pin. The stocking-frame was gradually simplified and improved; and having spread over France, Spain, and the Netherlands rapidly,—as well as throughout England, has continued to furnish in all those countries, as also latterly in Saxony, employment to many industrious, and frequently (as it has been proved by their inventions) very skilful mechanics. Out of 660 frames, in 1669, 400 were in London; three-fifths of the whole were employed in making silk goods. In 1695, 1500 frames were in London alone. In 1641 there were but two frames in Nottingham, and not 100 in the county. In 1710, 100 frames were destroyed in London on account of disputes about wages. In 1714 there were 2,500 frames in London, in Leicester 600, in Nottingham 400; altogether, about 8600 in this country. The trade soon began to escape from the company's protective coercion, and located itself most rapidly in the midland district. In 1753 the frames in London had decreased to 1000, and increased in Nottingham to 1500, and Leicester 1000; the total number was 14,000. Meantime *cotton* hose, which had been first woven on this machine in 1730, were getting into more notice and demand. Invention was in vigorous progress. The tuck rib was made in 1730. Jedediah Strutt patented his Derby rib in 1759; and while we are justified in describing the invention of Lee to have been, considering his times and circumstances, the greatest effort of mechanical genius of his own, and almost of any age, it was not less remarkably the precursor of a most extraordinary series of skilful variations of, and additions to, the stocking frame, so as to adapt it to the production of fancy work, and imitations of pillow lace. Though imperfect at first, these led in the course of the next 50 years after Strutt's patent to the invention of the point-net, pin, warp, and bobbin-net lace machines. In 1776 came Horton's patent knots; and soon after milled and elastic goods were made. About this time 300 frames were broken near Nottingham, because making spurious or unfashioned work. In 1782, out of 20,000 frames, 17,350 were in the three midland counties. Notwithstanding all the skill, industry, and capital employed, the hosiery trade, though enlarging its number of frames and the amount of production, has, during the past 50 years, suffered many depressions in the rates of wages, unattended by corresponding improvements in speed, in which the maximum was already attained. The number of frames in 1812 Blackner stated to be 29,590; yet the year before, Luddism had destroyed 687 frames, and the privations of the work-people were very severe. Having named some of the inventions directly emanating from the operations of the stocking-loom, of which a list made up to 1828, now in my hand, enumerates 100 of much importance and beauty, and to which as many nearly might be added since, it is prosper to remark that, although I do not expec- stocking making by hand will ever be superseded by rotary steam fabrication, yet the recent inventions of Mr. Whitworth, in Manchester, Mr. Thorburn, in Scotland, one it Nottingham, and one in Loughborough, a also a circular knitting-frame, said to be of Mr. Brunel's invention, are so ingenious as to demand high praise for skilful adaptation, if not for absolute independence of the principle of Lee's frame. It is interesting to observe that the period of which we have been speaking, namely from 1760 to 1800, so marked by the putting forth of mechanical genius in relation to the stocking-frame, had been equally important in collateral, and not very remote efforts in cotton spinning. Paul having spun cotton yarn by machinery in 1734, removed to Nottingham; his plan was improved there by James and Foster. Hargreaves, driven thither by riotous women, spun 84 threads at once, patented his machine, was pirated, and ruined. He died there in 1778. Hayse and Arkwright having spun cotton by rollers, the latter came to Nottingham, took out his patents of 1769 and 1775, in conjunction with Need, a hosier, and there he built his first mill. It was there also that in 1805 Mr. Samuel Cartledge succeeded first in causing cotton yarn of sufficient fineness and quality to be used in making lace, whether pillow or machine wrought.

*   *   *   *   *

Foreign competition has not, in reality, operated on the trade so prejudicially as has been thought. About 25,000 frames are in existence, and generally at work in Saxony, principally to order from the United States. But the amount of our exports of hosiery has never been important, and is rather increasing than otherwise; in 1837, 7497 dozens—in 1843, 147,507 dozens. With the nation in a state of prosperity, even our home consumption would furnish adequate demand for the produce of every British stocking-loom.—The workman in this country must labour with great activity and attention in ordinary cases. The art of frame-work knitting is not difficult to acquire; but the best fashioned work, and all fancy work, require a quick sight, a ready hand, and retentive faculties. In Saxony,

the hands make from 12 to 24 courses of loops per minute; they are not so ready in handling the frame as the English, and their materials are often not even, and soft. In this country the hands make from 24 to 42 courses per minute; they will average for hours 36 per minute, when working three hose together, and making heavy worsted goods.

* * * * *

In narrow frames the number of needles is from 170 to 600. In wide ones there are often 1500. Fashioned work is favourable to the workman, by relieving him during the narrowing and other operations which require change of labour and position. Wide frames, on which usually the unfashioned work and that which has to be shaped by the scissors is made, is consequently very trying, being continued with little interruption.

The constancy of muscular motion is favourable to the stocking-makers' health, and if the shop be well warmed and ventilated, sickness does not supervene in this employment, even so much as in many others. The failure of sight at an early age is common.

The machines (usually called frames, and from which these workpeople have acquired the name frame-work knitters) for the manufacture of hosiery are spread chiefly over upwards of 240 parishes in the three midland counties of Nottingham, Derby, and Leicester, lying between Chesterfield, northwards; Newark, on the east; Ashby-de-la-Zouch, westwards; and Market Harborough, to the south. This district is about 70 miles in length, and 45 in its greatest breadth; within its limits there are 60 parishes in the county of Nottingham where are more than six stocking-frames at work. These have all been visited for the purposes of this enquiry, and an account has been taken of each frame and its employment. The number of separate shops, or other working places, was ascertained to be (exclusive of a few of those in Nottingham, the whole of which were not visited separately, though the particulars of most have been ascertained, except as to gauges) 4621, and the number of frames in employment in this county is ascertained to be 14,879, and out of employ, or in smiths' hands, 1503;—total in Nottinghamshire, 16,382.

Also, in the above described area there are 100 parishes lying in the county of Leicester, where there are more in each than six frames at work. Of these about 60 have been visited, and most of them counted; in regard to the remaining 40, the returns have been furnished directly to myself or indirectly through my agent, who took the account of that district, by the secretaries of the trade at Leicester, Hinckley, and Loughborough respectively, and include the 6750 frames found in those three important seats of the manufacture. The number of frames in Leicestershire is, at work 18,558, unemployed and at smiths, 2,303;—total, 20·861.

Finally, there are 60 parishes in Derbyshire, in which are more than six frames at work; 50 of these have been visited and counted, and as to the other ten, including the frames in the town of Derby, local trade returns have been obtained. The number of frames employed is 6005, and unemployed 792; total, 6797 in the county of Derby.

* * * * *

Twelve years ago I stated the numbers to be about 33,000 in employ. Mr. Henson made them 36,000. Now, including the total number in the three counties, employed 39,442, and unemployed 4598, making together 44,040, and adding those found in other parts of England, 1572; in Ireland, 265; and in Scotland, 2605—there is now a total of 42,652 employed, and 5830 unemployed; thus making together 48,482 frames, forming the available machinery of this important trade.

ON THE RELATIVE ADVANTAGES OF ATMOSPHERIC AND LOCOMOTIVE PROPULSION.

Sir,—The remarks upon the above very important subject by "Omega," in your Magazine of Nov. 22nd, are decidedly in favour of the atmospheric principle, both as regards the all-important points economy and safety, and, in consonance, too, with the prevailing opinions on the subject. His suggestions as to the improvements that are still needed in this favourite system of railway construction are assuredly well-deserving of attention. I have myself devoted for a considerable time my attention to the subject, and have examined the drawings and working of several lines, and, having well studied their defects, I am now able to bring forward a plan of construction upon the atmospheric principle, which, in the opinions of several scientific friends, will render this system free from the defects alluded to by "Omega," and make it in every way the most advantageous for commercial and private purposes.

I am satisfied my new system will turn out a valuable and important one to society; and I intend very shortly to bring my plans before parties interested in constructing fresh lines, and in improving the old ones; in the mean time I shall take measures to procure the assistance of some party who

may feel disposed to join me in the undertaking. Yours obediently,

G. L. Smartt,

Enfield.

P.S. "Omega" omitted to notice in Pilbrow's system the violent contest between the atmospheric pressure upon the piston, and the pressure of the blocks upon the wheels when attempting to stop the train; guide wheels and racks must soon be worn and get out of gear. And again, should a spike, or other large-headed substance be thrown head first into a tube of this description, the consequences would be destructive to the piston, besides rendering extraction difficult.

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC., CAP. 65 FROM OCTOBER 24, TO NOVEMBER 25, 1845.

Date of Registration.	No. in the Register.	Proprietors' Names.	Address.	Subject of Design.
Oct. 24	568	Brookes Hugh Bullock	2, Chester-street, Grosvenor-place, Middlesex	Distance measurer for maps, charts, &c.
28	569	Green and Bentley	27, Upper George-street, Bryanston-square	Syphon-chimney funnel.
,,	570	Andrew Symington and Alexander Temple.	of Falkland Palace	Improved clock.
29	571	Henry Worthington and Wm. Bullough	Eccleshill, near Blackburn	Lathe sword with moveable stop rod.
31	572	Wm. Thorowgood and Wm. Besley	Fann-street, Aldersgate-street	English clarendon type.
,,	573	John Jones	Leeds	Excavating tool.
Nov. 4	574	John Inderwick	58, Prince's-street, Leicester-square	Galvanic pipe.
5	575	Gouger and Mayer	2, Bow-lane	Stock and shirt collar.
,,	576	Henry Methold Greville	Northampton	Spirit torch.
6	577	George Macfarlane	41, Gerard-street, Soho	Cornopean, or cornet a piston.
7	578	Newcomb and Mansell	35, Wapping, Liverpool	Reflecting luminator for astronomical and other purposes.
,,	579	Thomas Williams	Market-place, Willenhall, Staffordshire	Lock.
,,	580	William Palmer	144, Western-road, Brighton	The Brighton shower bath.
,,	581	John Aston	Birmingham	Design for the shape or configuration of the back of a button.
8	582	Edwin Heinke	103, Great Portland-street, Oxford-street	Diving helmet.
10	583	Peter Scott	9, South Bridge-street, Edinburgh	Improved shirt, called the V shirt.
,,	584	Charles Sheaf	New-street, Birmingham	Candlestick.
,,	585	Peter Mark Roget, M.D.	18, Upper Bedford-place, London	The stereotic chess and draught board.
19	586	Daniel Hodson	27, Gun-street, Spital-square	Silk polisher.
,,	587	Thomas Benbow	Camden-street, Birmingham	Fastening for bandages and stays.
25	588	Alexander Guthrie	54, New Bond-street	Gilet du prince.

NEW PUBLICATIONS CONNECTED WITH THE ARTS AND SCIENCES PUBLISHED IN SEPTEMBER, OCTOBER, AND NOVEMBER. 1845.

Scientific Memoirs (Part 13.) Translated from Foreign Journals, and the Transactions of Foreign Academies. Edited by Richard Taylor, F.L.S., F.R.A.S. Contents:—Mitscherlich, Reactions of Bodies by Contact—Plateau, Figure of a Liquid Mass freed from Gravity—Pouillet, Solar Heat, Radiation and Absorption—Mohl, Structure of the Vegetable Cell, with Two Coloured Plates—Romer, Chalk Formation of Northern Germany—Wartmann, Colour Blindness. 6s.

Kaemtz's complete Course of Meteorology, with Notes by C. Martins, and an Appendice by Lalanne. Translated, with Notes and Additions, by C. V. Walker, Editor of the Electrical Magazine. 12s. 6d.

The Art of Netting, with the Method of Making and Mending Fishing Nets Practically Explained and Illustrated with Etchings. By S. F. Every, Esq. 2s.

First Principles of Algebra for Schools, and Elements of Geometry for Schools. By Rev. George Fisher, Head Master of the Royal Naval Schools, Greenwich. Symbolically arranged 3s. each.

Self-Instructions for Young Gardeners, Foresters, Bailiffs, Land-Stewards, and Farmers, in Arithmetic and Book-keeping, Geometry, Mensuration and Practical Trigonometry, Mechanics, Hydrostatics and Hydraulics, Land-Surveying, Levelling, Planning and Mapping, Architectural Drawing, and Isometrical Projection and Perspective; with Examples showing their Application to Horticultural and Agricultural Purposes. By the late J. C. Loudon, F.L.S., H.S., &c., with a Memoir of the Author. Portrait and numerous Illustrations. 7s. 6d.

Railways, and their future Improvements, especially in a Military point of view: an Essay, recently submitted to, and approved of by, the Prussian Government. 1s.

Notes of the Cause tried at the Liverpool Summer Assizes, before Mr. Justice Cresswell and a Special Jury, August 27, 1845, between W. E. Newton and the Grand Junction Railway Company, for

an infringement of Letters Patent for Improvements in the construction of Boxes for the Axletrees of Locomotive Engines and Carriages, and for the Bearings or Journals of Machinery in general, and also for Improvements in Oiling and Lubricating the same. 2s. 6d.

AN ESSAY on the PROPERTIES of ANIMAL and VEGETABLE LIFE: their Dependence on the Atmosphere, and connection with each other, in relation to the functions of Health and Disease. By Edward James Shearman, M.D.

DOMESTIC ARCHITECTURE OF ENGLAND. Drawn and arranged by John Britton, F.S.A.; with Notices, Descriptive and Historical, by the Rev. Charles Boutell, M.A., Curate of Sandridge, and one of the Secretaries to the St. Alban's Architectural Society.

A TREATISE ON PAINTED GLASS, showing its applicability to every Style of Architecture. By James Ballantine.

MECHANICS' EXPOSITOR; being a complete Set of Tables for the use of Builders, Carpenters, Bricklayers, &c. By John Goldfinch. 1s.

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THE PHYSICAL ATLAS; a Series of Maps Illustrating the Geographical Distribution of Natural Phænomena. By Henry Berghaus, LL.D., F.R.G.S., Regius Professor of Geodesy, Berlin, and Principal of the Geographical Institute, Potsdam; and Alexander Keith Johnston, F.R.G.S., Geographer at Edinburgh in ordinary to her Majesty. Part I. 21s.

LIST OF ENGLISH PATENTS GRANTED BETWEEN OCTOBER 25 AND NOVEMBER 20, 1845.

John Davies, of Manchester, patent agent, for certain improvements in the method of dyeing and staining woven, or piece goods, or fabrics, and in the machinery or apparatus to be used for such, or similar operations. (Being a communication.) October 25; six months.

Benjamin Nickels, of York-street, Lambeth, machinist, for improvements in piano-fortes. October 27; six months.

Reginald Orton, of Villiers-street, Sunderland, surgeon, for improvements in life-boats, life-buoys, and apparatus for conveying persons ashore from wrecked or stranded vessels. October 27; six months.

Samuel Childs, of Earls-court-road, Kensington, wax-chandler, for improvements in the manufacture of candles. October 27; six months.

Dennis Jonquet, of Chateaudun, France, for improvements in machinery for preparing skins for tanning and dressing. October 31; six months.

Robert William Brandling, of Low Gosforth, Northumberland, Esq., for improvements in railways and railway carriages for the security and convenience of the public. October 31; six months.

Charles Henry Collins, of Lambeth, engineer, for improvements on atmospheric railways. October 31; six months.

Henry Clark, of Redcross-street, Cripplegate, London, oil merchant, for certain improvements in the preparation of materials to be employed for producing illumination. October 31; six months.

James Hardcastle, of Firwood, Bolton-le moors, Esq., for certain improvements in the methods of scouring, bleaching, preparing, dyeing and finishing piece goods, or woven fabrics. October 31; six months.

Thomas Forsyth, of Salford, Lancaster, engineer, for certain improvements in signals, or in the method of giving signals, which are applicable to the working of railways, and which are also applicable to maritime purposes, and for certain other improvements in the working of railways. October 31; six months.

Dalrymple Crawford, of Birmingham, gentleman, for certain improved means of, or machinery for arresting the progress of railway carriages and trains. October 31; six months.

Henry Waller, of Vauxhall-road engineer, for improvements in sluice cocks. October 31; six months.

Richard Archibald Brooman, of the Patent Office, 166, Fleet street, gentleman, for improvements in printing and figuring silk, cotton, and other textile fabrics. November 3; six months.

Richard Archibald Brooman, of the Patent Office, 166, Fleet-street, London, gentleman, for certain improvements in gas meters. (Being a communication.) November 3; six months.

Richard Biddle, of Leadenhall-street, surgical mechanician, for certain improvements in driving mills and other machines or machinery, by the power of the wind. November 3; six months.

Christopher Binks, of Friar's-grove, Durham, chemist, for certain improvements in manufacturing certain compounds of nitrogen, particularly cyanogen, ammonia, and their compounds, and the use or application in these manufactures, of a substance or substances not hitherto so employed. November 3; six months.

Chandos Hoskins, of Dublin, gentleman, for certain improvements in trusses. November 3; six months.

Thomas Edwards, of Islington Foundry, Birmingham, engineer, for certain improvements in steam engines. November 3; six months.

Paul Ackerman, doctor of medicine, of Skinner's-place, Size-lane, for certain improvements in harpoons and other similar instruments. November 3; six months.

George Ewart, of the New-road, zink manufacturer, for improvements in the manufacture of chimney pots. November 3; six months.

Thomas Bell, of Don Alkali Works, South Shields, for improvements in certain processes in the manufacture of alkali, which improvements are applicable to the purposes of condensation. November 3; six months.

Alfred Watney, of Wandsworth, gentleman, for improvements in the manufacture of horse-shoes, and in applying shoes to horses and other animals. November 3; six months.

George Minter, of Gerard-street, Soho, patent chair manufacturer, and Jonathan Badger, of Walworth, carpenter and builder, for improvements in the construction of easy chairs. November 4; six months.

Edward Augustin King, of Warwick-street, Middlesex, gentleman, for improvements in obtaining light by electricity. (Being a communication.) November 4: six months.

Richard Atha, of Walton, near Wakefield, engineer, for atmospheric engines. November 4; six months.

Charles Sanderson, of West-street, Sheffield, manufacturer, for improvements in combining steel and iron into bars for tyres for wheels, and for other purposes. November 4; six months.

Samuel Carson, of Norwood, gentleman, for improvements in treating eggs for the purposes of food. November 5; six months.

Henry Blumberg, of Camberwell-grove, distiller, for improvements in the purification of spirits for the use of brewing, distillers and rectifiers. November 5; six months.

George Scolfield, of Manchester, agent for certain improvements in machinery or apparatus to be employed for lithographic printing. November 5; six months.

William Thomas, Cheapside, merchant, for improvements in apparatus for impregnating liquids

with gases. (Being a communication.) November 5; six months.

Laura Laughton, late of Plymouth-grove, Manchester, but now of Everton, Nottingham, the wife of Edmund Laughton, of the same place, gentleman, for improvements in the manufacture of soap. November 6; six months.

Uriah Clark, of Leicester, dyer, for certain improvements in manufacturing and marking looped fabrics. November 6; six months.

John Soloman Bickford, George Smith, and Thomas Davey, all of Tuckingmill, Camborne, Cornwall, patent safety fuze manufacturers, for certain improvements in manufacturing the miners' safety fuze. November 6; six months.

John Campbell, of Bowfield, Scotland, bleacher, for certain improvements in the apparatus or machinery for drying and finishing of bleached cotton and other goods. November 6; six months.

Robert Burton Cooper, of Swinton-street, Gray's Inn-road, gentleman, for improvements in the manufacture of taps or cocks, and in stopping bottles and other vessels. November 6; six months.

Peter Armand Lecomte de Fontainmoreau, of Skinner's-place, Size-lane, for certain improvements in producing artificial fuel. (Being a communication.) November 6; six months.

Benjamin Donkin, of the Paragon, New Kent-road, civil engineer, for improvements on wheels as applicable to railway carriages, and on the mechanical contrivances by which railway carriages are made to cross from one line of rails on to another line, or on to what are generally called sidings. November 11; six months.

William Henson, of Skinner-street, St. John's-street-road, civil engineer, for improvements in machinery for weaving. November 11; six months.

Christopher Vaux, of Frederick-street, gentleman, for improvements in machinery or apparatus for tilling land. November 11; six months.

Charles Frederick Bielefield, of Wellington-street, Strand, papier machié manufacturer, for improvements in the manufacture of embossed leather and other fabrics and articles. November 11; six months.

George Hill Dutton, of Dutton, brewer, for certain improvements in conveying intelligence from one part of a railway train to another. November 11; six months.

Samuel Thomas Cromwell, of Romsey, Hants, teacher of music, for improvements in apparatus to be applied to piano-fortes. November 11; six months.

Robert James Hendrie, jun., of Blossom-street, Norton Folgate, dyer, for an improvement in the preparation of silk. November 11; six months.

Jacob Brett, of Hanover-square, Middlesex, Esq., for improvements in printing communications made by electric telegraph. (Being a communication.) November 13; six months.

Joseph Ramor Yglesias, of Mark-lane, London, merchant, for a new mode of application and combination of mechanical arrangements (or of mechanical and hydrostatical arrangements) already known and in use for the purpose, by such application and combination, of augmenting the power or moving force of first moving machines or engines. (Being a communication.) November 13; six months.

Thomas Palmer, of Tavistock, in the county of Devon, currier, for certain improvements in mine-lifting machinery, which are also applicable to other purposes. November 15; six months.

John Ayre, of Tynemouth, in the county of Northumberland, sailmaker, for an improved fabric for sailcloth. November 15; six months.

Edward Hall, of Dartford, Kent, civil engineer, for an improved double cylinder condensing engine. November 15; six months.

Stephen R. Parkhurst, of Liverpool, mechanist, for a method of propelling vessels. November 17; six months.

James Boydell, jun., of the Oak Farm Works, Dudley, iron-master, for improvements in the manufacture of hinges and handles of knives and other instruments. November 17; six months.

James Boydell, jun., of the Oak Farm Works, Dudley, iron-master, for improvements in the building of ships and other vessels. November 17; six months.

William Newton, of Chancery-lane, civil engineer, for improvements in manufacturing types and other similar raised surfaces for printing. (Being a communication. November 17; six months.

Frederick Oldfield Ward, of Cork-street, Middlesex, gentleman, and Malcolm William Hilles, of Henrietta-street, Covent-garden, gentleman, for improvements in the construction of railways, and in machinery and apparatus for working carriages thereon. November 18; six months.

Richard Wright, of Hermitage-terrace, sugar refiner, for improvements in refining sugar. November 18; six months.

Christopher Vaux, of Brighton, gentleman, for improvements in apparatus or machinery for preventing accidents to carriages and passengers on railways, parts of which improvements are applicable to save lives and property in other places. (Being a communication.) November 18; six months.

Henry Dircks, of Nicholas-lane, London, engineer, for improvements in the means of obtaining and preparing extracts from certain vegetable matters, and in the apparatus connected therewith, which apparatus may be also applied to other similar purposes. November 18; six months.

Edward Brown Wilson, of Leeds, engineer, for improved apparatus applicable to swivel bridge and turn tables. (Being a communication.) November 18; six months.

John Finlay, of Glasgow, ironmonger, for a certain improvement or certain improvements in raising and lowering gas, and other lamps, lustres, and chandeliers. November 18; six months.

Henry Buckworth Powell, of Pennington-house, Southampton, lieutenant and captain in the Grenadier Guards, for certain improvements in carriages to be used on rail and other roads. November 18; six months.

William Malins, of Mansion-house-place, London, and West Bromwich, Stafford, iron master, for improvements in constructing roofs and other parts of buildings of iron or other metals, and in the preparation of the materials of which the same are or may be constructed. November 18; six months.

Moses Poole, of London, gentleman, for improvements in raising and transporting earth and other heavy bodies. (Being a communication.) November 18; six months.

James Laming, of Mark-lane, London, merchant, for improvements in making the cyanides and ferrocyanides of potassium and sodium. (Being a communication.) November 18; six months.

Thomas Hunnybun and Edward Venden, of Cambridge, coachmakers, for improvements in that description of passenger carriages called omnibuses. November 20; six months.

Frederick Gye, of South Lambeth, Surrey, gentleman, for improvements in moulding sugar. (Being a communication.) November 20; six months.

Thomas Samuel Parlour, of Holloway, in the county of Middlesex, for improvements in propelling vessels. November 20; six months.

Nathaniel Chappell, of Arcadian-villa, Cumberland-road, Bristol, gentleman, for improvements in the manufacture of worts. November 20; six months.

John Depledge, of the Thorncliff iron-works, near Sheffield, draughtsman, for a certain improved metallic broacher. November 20; six months.

William Johnson, of Farnworth, near Bolton, agent, for certain improvements in machinery, or apparatus for preparing cotton and other fibrous substances for spinning. November 20; six months.

William Corseaden Thompson, of Liverpool, master mariner, for certain improvements in machinery, or apparatus for propelling vessels on water. November 20; six months.

James Donaldson, of Haslingden, Lancaster, woollen-printer, for certain improvements in the processes of scouring, bleaching, and washing wool, cotton, silk, and other fibrous substances, both in a raw or manufactured state. November 20; six months.

Ernest Edge, of Manchester, mechanic, for certain improvements applicable to the wheels and axles of engines, tenders, carriages, and wagons, to be used on railways. November 20; six months.

George Skinner, merchant, of Stockton-upon-Tees, and John Whalley, of South Stockton-upon-Tees, earthenware manufacturer, for certain improvements in the manufacture of earthenware pastes and vitreous bodies, and also a new composition and material for the same, with certain new modes of combination thereof, which improvements, compositions, and combinations, are applicable to the manufacture of earthenware pastes, vitreous bodies, slabs, tiles, and pavement, and various other useful and ornamental purposes. November 20; six months.

Eugene Francois Vidocq, of Gallerie, Vivienne, France, for improvements in combining materials to be employed in the manufacture of tea-trays, boxes, trunks, table-covers, oil-cloths, and other articles to be used in place of the materials now employed in such manufactures. November 20; six months.

LIST OF PATENTS GRANTED FOR SCOTLAND FROM THE 22ND OF OCTOBER TO THE 22ND OF NOVEMBER, 1845.

John Campbell, bleacher, Bonfield, Renfrew, in Scotland, for certain improvements in the apparatus or machinery for drying or finishing of bleached cotton and other goods. Sealed, October 24, 1845.

James Higgins, of Salford, Lancaster, machine maker, and Thomas Schofield Whitworth, of Salford, aforesaid, mechanic, for certain improvements in machinery for preparing, spinning and doubling cotton, flax and similar fibrous material. Oct. 24.

Arthur Smith, of St. Helen's, Lancaster, manufacturing chemist, for certain improvements in the manufacture of soda ash. October 28.

Thomas Moss, of Gainsford-street, Barnsbury-road, Middlesex, engraver, for improvements in printing and preparing bankers' notes, checks, and other papers, for the prevention of fraud. Oct. 29.

John Samuel Templeton, of Sussex-place, Kensington, Middlesex, artist, for improvements in propelling carriages on railways. October 29.

Robert Clark, ships-painter, and Alexander Pirnie, ships-smith, both of Newburgh, Fife, for certain improvements in steering vessels. October 29.

John Ayre, of the borough and parish of Tynemouth, Northumberland, sailmaker, for an improved fabric for sailcloth. October 30.

Thomas Howard, of the King and Queen Iron Works, Rotherhithe, Surrey, iron manufacturer, for improvements in rolling iron bars for suspension bridges and other purposes. November 5.

James Hardcastle, of Firwood, Bolton-le-Moors, Esq., for certain improvements in the method of scouring, bleaching, preparing, dyeing and finishing piece goods, or woven fabrics. November 6.

Edward Wilkins, 26, Surrey-place, Old Kent-road, St. George's Southwark, Surrey, tanner anp currier, for an improvement or improvements in the manufacture of leather.

John Davies, of Manchester, for certain improvements in the method of dyeing or staining woven, or piece goods, or fabrics, and in the machinery or apparatus to be used for such or similar operations. (Being a communication from abroad.) November 10.

Robert Griffiths, of Havre, France, George Hinton Bovill, of Millwall, Middlesex, and George Hennett, of Bristol, engineer, for improvements in the construction of parts of apparatus used for propelling carriages and vessels by the atmosphere, and improvements in propelling carriages and vessels by atmospheric pressure. November 11.

Angier March Perkins, formerly of Harper-street, but now of Francis-street, Regent-square, Saint Pancras, Middlesex, civil engineer, extension for five years from the 2nd of November 1846, of a patent granted to him by King William the Fourth, bearing date the 2nd of November 1832, for his invention of certain improvements in the apparatus or method or methods of heating the air in buildings, heating and evaporating fluids, and heating metals. November 11.

William Longmaid, of Plymouth, Devon, gent., for certain improvements in the manufacture of chloride, in treating sulphurous ores and other minerals, and in obtaining various products therefrom. November 12.

Alfred Watney, of Wandsworth, Surrey, gentleman, for improvements in the manufacture of horseshoes, and applying shoes to horses and other animals. November 12.

John Lord, of Friday Bridge, Birmingham, merchant, for improvements in supplying steam boilers with water. (Being a communication from abroad.) November 17.

Richard Prosser, of Birmingham, civil engineer, for improvements in the manufacture of metal tubes, and in the machinery or apparatus for producing the same, and in apparatus for fastening tubes in their intended places in steam boilers and other vessels. November 18.

Robert James Hendrie, Jun., of Blossom-street, Middlesex, dyer, for an improvement in the preparation of silk. November 18.

Moses Poole, of Serle-street, Middlesex, gentleman, for certain improvements to hinder the oxydation of iron in all its various states of cast metal, steel, malleable iron, and also to render malleable iron more hard and durable. (Being a communication from abroad.) November 19.

Thomas Bell, of the Don Alkali Works, South Shields, for improvements in certain processes in the manufacture of alkali, which improvements are applicable to the purposes of condensation. November 19.

Charles Hancock, of Grosvenor-place, Middlesex, artist, for certain improvements in cork and other stoppers, and a new composition or substance which may be used as a substitute for, and in preference to cork, and a method or methods of manufacturing the said new composition or substance into bungs, stoppers and other useful articles. November 20.

Charles Smith, 13, Newcastle-street, Strand, for new and improved methods in the construction and application of a variety of cooking culinary and domestic articles and utensils, some of which are applicable to cleaning, and a variety of similar useful purposes. November 20.

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

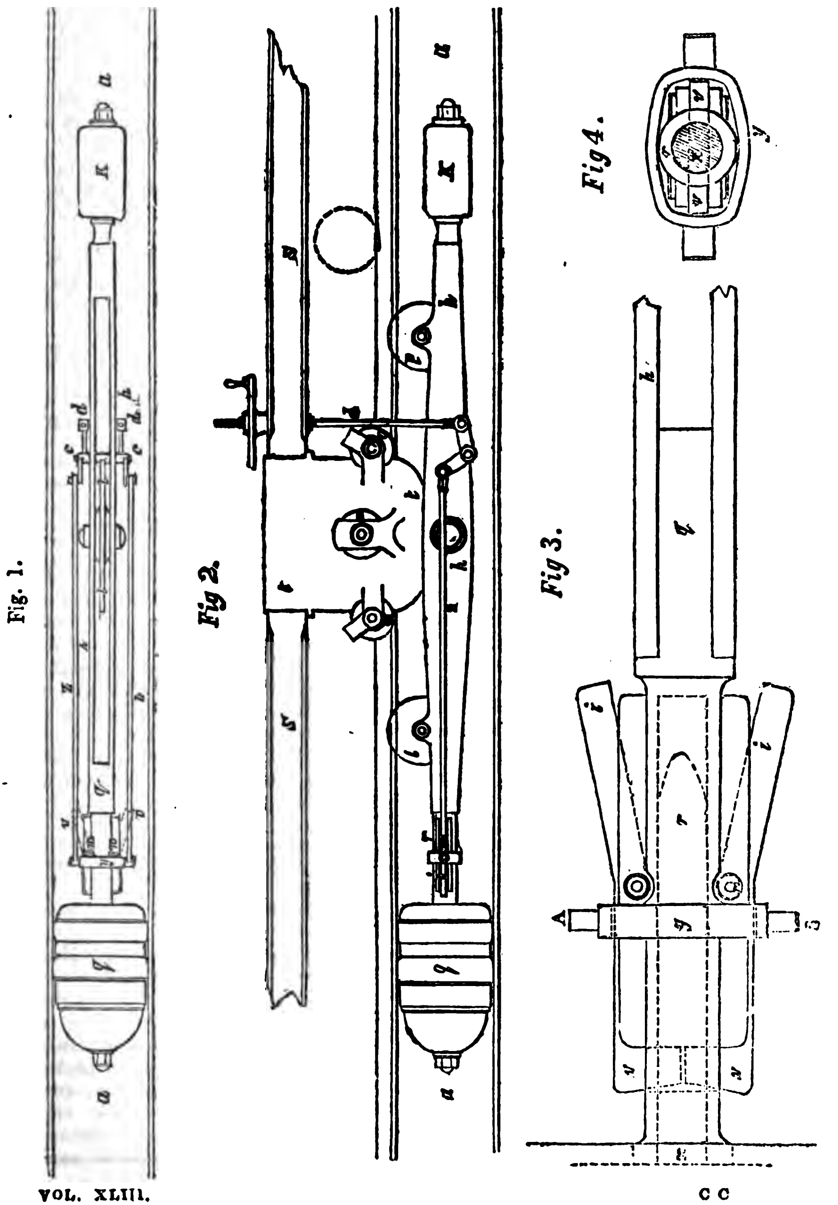
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1165.] SATURDAY, DECEMBER 6, 1845. [Price 3*d*.

Edited by J. C. Robertson, No. 166, Fleet-street.

MALLETT'S ATMOSPHERIC RAILWAY IMPROVEMENTS.



THE ATMOSPHERIC RAILWAY—PLAN FOR RELEASING THE HEAD OF THE TRAVELLING PISTON INSTANTANEOUSLY IN CASE OF ACCIDENT ON THE LINE OR TO THE TRAIN. BY ROBERT MALLETT, ESQ., A.B., MEM. INST. C.E.

Professor Barlow, in his Report to the Board of Trade, remarks upon the inefficiency of Clegg's contrivance for suddenly bringing an atmospheric train to rest in case of accident, namely, by opening a valve in the back of the piston; and justly concludes that "the atmospheric system will be inferior in point of safety to rope machinery, without some contrivance for totally and immediately disconnecting the piston from the train." The piston, *with its coulter*, &c., could not possibly be let go from the leading carriage, without the destruction of more or less of the long valve, however formed, by its first plunge forward; but the piston head may be released from all the rest, and let to shoot forward within the tube without injury either to itself or the main or valve. This arrangement for doing so I devised in 1842.

Figs. 1 and 2 are a horizontal and vertical longitudinal section of the main, with piston, coulter, &c. fitted for my own improved valve, and with gear for releasing the piston head.

Fig. 3, is an enlarged plan of the clutch for retaining or releasing the piston head, and fig. 4 a transverse section of same, through A B. The same letters refer to all. *a*, the main; *q*, the piston head; *h*, the rib or frame of the piston; *k*, the balance weight; *l m n o p*, the lifting rollers of tubular valve; *t*, the coulter; *s*, the perch of leading carriage. The piston frame at *r* consists of a cylindrical socket, into which a solid cylindrical bar, or plug, fast to the piston head, fits, as shown in dotted lines, fig. 3. At either side of *r* are provided wings, forming rabbates, into which the two clutches, *v v*, are placed, and are free to move back and forwards on the centre pins *w w*. The hooked ends of the clutches, when in the position of figure 3, are engaged with the plug, *x*, of the piston head, by slots or cotter holes at either side of it, which they enter. The collar, *y*, slides along over the clutches, and when moved towards *r*, holds them in their place, and keeps the piston head securely attached. When the piston head, however, is required to be suddenly detached, the sliding collar, *y* is pulled back towards *q*, and as it passes over the projecting ends of the clutches, *v v*, which are inclined outwards, it pulls them out of hold with the bar *x*, of the piston head, and the latter being released, flies away, leaving the piston frame, &c., behind.

The motion of the collar, *y*, is produced by the rods, *z z*, attached to it, and to the levers, *c c*, moved at the other end by the rods, *d d*, which unite into a single rod, passing vertically up through the valve slot, cranked to one side to let the tubular valve pass, and finally moved by a hand-wheel, whose centre is a fixed nut, taking into a rapid screw on the rod *d*. This wheel is at the immediate command of the conductor.

GEOMETRICAL RECTIFICATION OF THE CIRCLE.

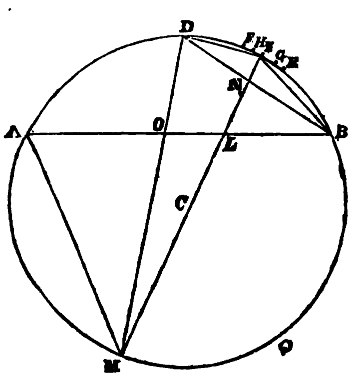
Sir,—In your Number 317, an intelligent correspondent of yours, "O. C. F.," whom I believe I am correct in assuming to have been a late highly distinguished professor of mathematics, did me the honour in noticing a demonstration of mine, to say, "It will also be seen, that the *ultimate* result would actually rectify the proposed arc, that is to say, would produce and present a right line that should be equal to it. This is, in *theory*, a beauty that Archimedes and Newton would have admired."

Now, Sir, I have referred to this extract, not to gratify any feeling of egotism which such marked approbation of so eminent a mathematician might almost excuse one for entertaining; but because, that under the sanction of this authority I am going to submit to the public through the medium of your valuable journal a demonstration, based

upon somewhat similar principles, according to which, by the simple process of repeated bisections I am enabled to obtain an arc, which shall be *one-third* of any given arc.

The mode of proceeding is this: Bisect the given arc, then bisect the half at *either* side; again, bisect its half, that is, the quarter of the whole on the *contrary* side; then that half of this last, or eighth of the whole which lies on the *former* side, and so on; let the bisections be supposed to be continued *ad infinitum*, when the ultimate submultiple arc would become infinitely small; then the point of *bisection* of the submultiple arc will *ultimately* coincide with the point of trisection of the given arc.

Thus: let A B be the given arc of the circle A B Q; bisect it in D; again,



bisect either half arc, say that to the *right* hand, D B in E; then bisect the half arc D E, lying to the *left* in F; then, again bisect the half arc F E on the *right* in G; again bisect F G to the *left* in H, and so on alternating, the bisections from right to left *ad infinitum*; ultimately the infinitely small submultiple arc will vanish, and the *ultimate* point of *bisection* Z of the *ultimate* submultiple arc will coincide with the point which *trisects* the given arc A B.

This can be proved arithmetically at once on the well-known problem for finding the sum of a geometrical series of minor inequality. For it is obvious, that the arc D F is $\frac{1}{4}$ of the arc A D; again, the arc F H is $\frac{1}{4}$ of the arc D F and so on. Therefore, the arc A Z ($=AD+DF+FH+$&c.,) will be the sum of a series of arcs of a descending geometrical progression, whose common ratio is $\frac{1}{4}$ and the first $AD=\frac{1}{2}$ the given arc A B; the second term, $DF=\frac{1}{8}AB$; and their difference $=\frac{3}{8}AB$; therefore the arc A Z the sum of the series of arcs (equal to the square of A B divided by $\frac{3}{8}AB$,) is equal to $\frac{\frac{1}{4}AB^2}{\frac{3}{8}AB}=\frac{2}{3}AB$. Q.E.D.

Could we therefore find the sum of a series of arcs in a descending geometrical series, the same as we can find the sum of a similar series of right lines, the problem of *trisecting* any arc could be solved by a *finite* geometrical process at once.

The proof can also be *geometrically* exhibited thus: let A Z be any arc; take Z B equal to half the arc A Z; Z B will therefore be a *third* of the arc A B, which will thus be *trisected* in Z. Draw the chords C B and Z B; also through Z and the centre C draw the diameter Z M, cutting the chord A B in L. Draw the radius A B. Now, since the arc B Z is equal to half the arc A Z, the angle B C Z at the centre is equal to the angle A B Z at the circumference. Therefore the triangles B C Z, L B Z having a common angle at Z are equiangular and similar, consequently the triangle L B Z is isosceles and L B = the chord Z B. Hence, we prove that the radius C Z, which trisects any arc A B in Z, will intercept on the chord A B, a part L B equal to Z B, the chord of the intercepted arc Z B, which is equal to $\frac{1}{3}$ arc A B. Bisect the arc A B in D; draw the chord D B, cutting the radius C Z in N; draw also the chord D Z. Now, it is obvious that the arc $DZ=\frac{1}{3}$ the arc D B; therefore, the intercept D N = the chord D Z. In like manner, if we bisect the arc D B in G. the intercept on the chord of D G by the radius C Z will be equal to the chord of the arc G Z, so that in the radius C Z, will be found the *loci* of those points of intersection, which cut off from the chords of the arc A B and its submultiple arcs DB, D G, G H, &c., parts equal to the chords of their third arcs. The *ultimate* intersection, therefore, will be found in Z, the extremity of the radius C Z, and will coincide with it, consequently, the ulti-

mate point of *bisection* of the submultiple arc coincides with the point of *trisection* of the arc A B. Q.E.D.

It was in this way, indeed, that I myself arrived at this conclusion, which I afterwards verified by considering the relations of the arcs A D, D F, F H, &c., whose sum constitute the arc A Z, and which I observed to form a geometrical series of minor inequality with a common ratio $\frac{1}{4}$.

There are some interesting properties connected with the chords of these arcs, &c. Thus it is obvious, that the square of B Z, the chord of the arc B Z, is equal to the rectangle under radius and the intercept L Z; in like manner the square of D Z, the chord of the arc D Z, is equal to the rectangle under radius and the intercept N Z; consequently, the intercepts L Z, N Z, &c., are as the squares of the chords B Z, D Z, &c. This might be seen in another way, by observing that the intercepts are double the versed sines of the arcs B Z, D Z, &c.

Draw A M, B M, also M D cutting A B in O; then the triangles A M L, Z B L being similar, the triangle A M L is an isosceles triangle, and the chord A M = L M the remaining intercept of the diameter; and by parity of reasoning, the chord B M = N M; so that L N intercepted between A B, the chord of the arc, and D B the chord of half the arc, is equal to the difference of the chords A M, B M; and consequently is a mean proportional between A L and O B − A O, the former, A L, being the difference of the segments formed by letting fall a perpendicular from M on the chord A B, the latter, O B − A O, being the difference of the segments formed by the line M O which bisects the angle A M B.

I am, dear Sir, yours very truly,

WILLIAM S. VILLIERS SANKEY, A.M.

September 16, 1845.

RECIPROCATING AND CRANK-WORKED FLOATING-ENGINES, &C.—REPLY TO "A FIREMAN'S" NOTES. BY MR. BADDELEY.

"His notion fitted things so well,
That which was which he could not tell;
But oftentimes mistook the one
For th' other, as great clerks have done."

BUTLER.

Sir,—I could only account for the absence of all mention of the floating fire-engines in Mr. Braidwood's paper "On the Means of rendering large Supplies of Water available in case of Fire," by supposing they were omitted for the purpose of avoiding a comparison between the two modes of working now in use,—the reciprocating and the rotary. Having adduced several striking proofs of the correctness of the opinion I have ever held of the superiority of the crank-worked engines, I am taken up by "A Fireman," who admits it to be true "that a rotary motion is generally considered to be more favourable for the exertion of human strength than a reciprocating," except for *fire-engines!* He gives us no explanation, however, of the omission (the *part* of Hamlet) to which I alluded. In my "Strictures" I have drawn a broad and well-marked distinction between *land-engines*, for which (as I have already stated) peculiar circumstances render the reciprocating movements most eligible, and the *floating-engines*, for which the rotary movement has many important advantages. "A Fireman" endeavours to confound this important distinction by including both under the generic term of *fire-engines;* but this equivocation will avail him nothing with your readers. He wishes to make it appear that the reciprocating movement is quite equal, if not superior to the rotary, by giving an account of a somewhat celebrated trial that came off in the London Docks, but of which I have previously given a somewhat different version. Whether from misunderstanding (misreading) his instructions, or "with more trickiness than candour," I know not, but by means of a *trifling error*, the experiments are made to support "A Fireman's" view of the case, until the following week, when he supplies a correction which puts an entirely new face upon the matter, and completely spoils his story. I therefore beg leave to repeat *his* amended version of this trial, and could desire no stronger evidence from my opponents of the accuracy of my former statements.

No. of Experiments.	Brigade Engine, Reciprocating.		Dock Engine, Crank-worked.		Remarks.
	Nose-pipe.	No. of men.	Nose-pipe.	No. of men.	
1	$1\frac{3}{4}$in.	90	$1\frac{1}{2}$in.	45	Brigade decidedly the advantage.
2	$1\frac{1}{2}$in. bare	90	$1\frac{1}{8}$in.	45	Equal.
3	$1\frac{1}{8}$in. bare	45	1in.	45	Dock decidedly the advantage.
4	1in. bare	45	$1\frac{1}{8}$in.	45	Equal.

It is necessary to explain that the "decided advantage" merely refers to the distance to which the water was thrown; at no time during these experiments was there any comparison between the *quality* of the two jets; that of the reciprocating engine was irregular and spreading, and at sixty feet would hardly have gone through a casement, while the jet of the crank-worked engine was beautifully compact and steady, and might have been put through a single quarry. The same striking difference has always been apparent between the working of these engines, fully sustaining the opinion of a writer before quoted, (vol. xxxiv., p. 169,) that "there is a decided superiority in the working of the rotary engines over those of the alternating kind. The relative uniformity of motion in all the working parts is highly favourable to the development of the utmost power of hydraulic or pneumatic machinery of this description. Unless it can be shown that an absolute loss of power results from the application of manual power to rotation, no one will, I apprehend, for a moment, question the superiority of the uniform and equable motion of the crank-worked piston,—the difference in the performance of which, as compared with those of percussive pistons, is very striking!"

While working with only half the number of men, the performance of the crank-worked engine was but little below that of the reciprocating, whereas, when tried with an equal number of men, its superiority was strikingly manifest. There is a vast amount of humbug in "A Fireman's" remarks about "expert and inexpert hands, picked men," &c., upon which I need not dwell, merely observing that there is scarcely a word of truth in these statements.

"A Fireman" endeavours to throw upon Mr. Walker, the respected ex-president of the Institution of Civil Engineers, all the responsibility of the adoption of the reciprocating motion in lieu of the rotary, in the modern floating engines; after what I have stated in your pages, however, nothing but the case actually submitted to Mr. Walker, and his opinion thereon, will remove the suspicion which attaches to this transaction. "A Fireman" quotes my commendatory notice of the new floating-engine, from p. 169, of vol. xxxiv., but dishonestly suppresses the qualifying remarks in the succeeding paragraph, in which I advanced the superiority of a different construction, and by means of this despicable and paltry trick he tries to bolster up a charge of "Jim Crow*ism*" for which there exists no real foundation.

My assertion that the quantity of water delivered by fire-engines is capable of being increased from 10 to 25 per cent. beyond the cubical contents of the barrels, is so contrary to anything within the scope of "A Fireman's" experience, that he concludes it to be an attempt to impose upon the gullibility of your readers. I stated at page 230 of your last volume, that the quantity of water delivered by an engine of a given size working at different speeds, is affected by contingencies, which Mr. Braidwood's paper, as well as his ordinary practice, shows him to be unacquainted with. "A Fireman" confirms my statement as regards Mr. Braidwood's, as well as his own unacquaintance with the circumstance; and yet upon the strength of his own "most lamentable ignorance on the subject, and his exceeding presumption (ignorance's usual companions)" he flatly denies my statement, and vouches for my "fact" being "no fact at all." Modest youth! Permit me to observe, that since "A Fireman's" contradiction appeared in your July number, being accidentally present at the trial of a very excellent engine (with 6in. barrel and 8in. stroke,) built for his grace the Duke of Sutherland, I took the opportunity of testing the quantity of water this engine was capable of delivering, and in the presence

of his Grace's engineer and other credible witnesses, 78 gallons of water were lifted by suction, and delivered in 80 strokes of the engine! On several former occasions the 78 gallons* have been delivered in 78 strokes of the engine, but in this trial the speed was not quite sufficient at the commencement. Dear-bought experience is best, and, therefore, although I desire to reap no benefit from "A Fireman's" ignorance, I will make him an offer, which, as he is so exceedingly positive of his own superior knowledge and attainments in this department of practical science, he cannot hesitate to accept. Let him place the sum of fifty pounds in the hands of three gentlemen (you, Sir, being one—myself and "A Fireman" will each name another) for some public charity, and I will undertake to show him—not the putting of a quart into a pint pot, nor yet getting into the pot myself—but the delivery by a fire-engine of upwards of 20 per cent. more water than the cubical contents of the barrels! Moreover, I will explain to his entire satisfaction the *reason why* this phenomenon obtains, and why it inevitably *must* be so! If I fail in the first particular, his money shall be returned to him.

"A Fireman" next takes up the trial of the two London-engines, (7in. barrels,) coupled against one with 9in. barrels, in June, 1839, as reported in vol. xxxi., p. 250. The result of this trial satisfied most of the spectators that the capacity of the 9in. engine was quite equal to that of the two 7in., although Mr. Braidwood thought them equal to a 10in. The contradiction of my report at this distance of time by an anonymous writer looks pre-eminently suspicious, and only merits notice from the authenticated report of Mr. Braidwood, given at p. 44. This report, as well as the circumstances connected with the trial, are such as no well-wisher to Mr. Braidwood would drag into publicity, and I sincerely regret that the imprudence of "A Fireman" compels me in self-defence to observe that "the report" is just such a one as might have been drawn up by the least informed among the spectators, or by any of the good old dames who supply her Majesty's lieges with Pomona's fruit; and, however well adapted for the atmosphere of the Watling-street committee-room, cuts but a sorry figure in a scientific journal.

Your readers will perceive that no data are given for elucidating the question at issue, the relative capacity of the single or united engines. We are told that the men were not properly proportioned to their work, that the large engine should have had but thirty-two men and four-tenths of a man—an impossible quantity! Had it been four-ninths of a man, four tailors might have met the exigency. The fact is, there is an affected nicety in some matters which contrasts oddly with the omission of other particulars. The report makes no mention of the relative speeds of working, nor is the handle-room at each engine given, although they are matters materially affecting the result of the experiment. It is especially mentioned that the united engines worked through sixty feet of leathern hose, and the large one through only 40 feet; but it is NOT stated that the united streams only passed through a portion of this length, which was also of greater capacity than that through which the whole stream of the large engine was worked. The Liverpool engine (9in. barrels) was made (contrary to the wishes of its builder) with a deficiency of handle-room, and a contracted water-way in the hose. At the trial, 36 men were crowded upon handles only made for 28, in consequence of which they worked at so great a disadvantage that they never realized the speed of the London engines, which had but 18 men with handle-room for 28. Under these disadvantages, however, the performances differed so little that the advantage was claimed by both sides, and it was, at least, evident to impartial observers, that had the speed in each case been the same, the capacity and performances of the Liverpool engine would have been fully equal to those of the two London ones. My own opinion is that the performance of the Liverpool engine would have been nearly as good with 26 as with 36 men, which would have made a vast difference (nominally) in its favour.

"A Fireman" attaches great importance to the "attested report," but, to my thinking, to have any weight, it should have been signed by both the parties to the trial,—the *Liverpool* as well as the *London* superintendent; or, what

* I was limited to this quantity, being exactly that held by the barrel into which the water was delivered.

would have been still better, by some competent, disinterested, and impartial witnesses, of whom several were present. It must have been a very different report from Mr. Braidwood's, however, to have obtained their signatures. The circumstance of Mr. Braidwood's drawing up such a one-sided and imperfect report, and calling upon a tradesman to sign it, whom we may suppose hardly free to refuse, is by no means creditable. To parade such a slovenly document before your readers, "A Fireman" must be lost to all sense of shame himself, and have very little consideration for the reputation of others.

Apologising for the length of this letter, I remain, Sir,

Yours respectfully,
WILLIAM BADDELEY.

29, Alfred-street, Islington,
Nov. 19th, 1845.

EXPERIMENTS IN SCREW PROPELLING—A NEW PROPOSAL.

Sir,—In the *Mechanics' Magazine*, No. 1163, page 349, I find an account of the *Great Britain's* fourth voyage. It appears that she has been very unfortunate in her two last voyages across the Atlantic, having in both cases had her propeller disabled. Nor is this to be wondered at, all circumstances considered, particularly the enormous depth of the arms of her propeller, whose extremities were revolving at the rate of 30 miles an hour, while the axis of the screw advanced only between 10 or 11 miles an hour. So great a velocity at the extremity of the blades, would not have been of any injury to the propeller, had the blades been turned more edgeways, so as to evade the resistance which the water exerted against them. But when we come to consider the great length of spiral given to the blades, being calculated to describe a complete revolution on the axis of 25 feet in length; and that the screw is only a part of the complete revolution of the spiral, it must have assumed more the appearance of a paddle-wheel than the appearance of a screw. As the blades were almost straight to the axis, therefore, when the screw revolved, the face of the blades met the water dead flat, or nearly so; for, the great angle of its spiral could not permit the blades to revolve edgeways to any sensible degree; and by the rapidity with which their extremities were revolving, it is easy to conceive that the resistance from the density of the water exerted against them must have been enormous.

When I read the account of the construction of this stupendous screw in your Magazine, No. 1151, page 154, I was impressed with a very unfavourable opinion of it. I doubted its efficiency in strength, although neither material nor labour, was by any means spared to render it capable of resisting whatever violence it might be exposed to. Neither did I augur better of its propelling power, for although it propelled this gigantic vessel at the rate of 10 or 11 miles an hour,—not *averaging*, however, more than 7 knots—I could not consider this to be a very great speed compared with the enormous power applied to it. As I have stated before, the blades of the screw being almost straight to the axis, three-fourths of the power of the engines were employed in overcoming the resistance of the water, so much so, that had the screw been only partly immersed in the water, instead of propelling the vessel forward it would have propelled her sideways.

As I take a very great interest in the subject, I was desirous to illustrate experimentally the objections, I have advanced against the *Great Britain* screw propeller; and with that view, I had two screws made of 2 feet long, and with four blades, and only 3 inches deep. The blades of one of these two screws make a complete revolution on the axis in 2 feet, and forms by itself an entire screw. The blades of the other screw are calculated to perform a complete revolution in 8 feet spiral; but being only 2 feet long, it forms only one-fourth of its revolution. I fitted these screws on a frame separately, and made them to revolve rapidly on their axes; and by this simple contrivance, I obtained the following interesting and satisfactory results. I found that the screw of 2 feet spiral drew in the air at one end, and blew it off with great violence at the other, while but a slight current of air was felt at an inch from the circumference; and a sheet of paper laid at a short distance under the screw, rushed along it as if it had been pulled suddenly with the hand. Of course, this was effected by the wind rushing along the blades of the screw;

and in all this, there was nothing but a very natural result of the spiral form; but nevertheless, I was very much pleased to see it. In repeating the same experiment with the screw of 8 feet spiral, I found quite a different result. The wind, instead of rushing along the blades, as in the former case, was blowing with violence at right angles to the axis of the screw, and was not at all felt at its extremities. Here we had exemplified the very effect produced by the screw propeller of the *Great Britain;* the water is thrown off at right angles to the axis of the propeller, in the same way as the wind was blown off by my little screw.

It is of no use, however, finding fault unless one is prepared with a remedy. I beg therefore to propose a new method of screw propelling, which I feel confident would prove capable of propelling a vessel with perfect safety at a much greater velocity than any yet obtained.

I propose to construct a screw of 100 feet long with four blades of 12 inches deep, and 2 feet spiral; I would enclose it in a tube within which it should revolve freely; and this tube should be laid along the keel of the vessel, and the ends of this tube should pass through the stem and stern posts. The fluid would of course rush through the apertures, and would fill the tube throughout. The screw being enclosed therein, would have the same power of propulsion as if it were exposed to the open water, while it would be entirely protected from all external dangers. The tube might be made of wood, which would answer perfectly well.

Let us now proceed to speculate upon the power of a screw of 100 feet long with four blades of 12 inches deep and 2 feet spiral.

It is obvious that a screw of this description would have a firm hold upon the water, consequently an immense power to propel, as there would be no less than 400 spiral faces to draw the fluid.

Therefore, if motion be communicated to the screw to revolve at the rate of 1,000 revolutions in a minute, the screw would have advanced 2,000 feet. But suppose there should be 5 per cent. of slip, the screw would have propelled the ship 1,900 feet in a minute, which would be at the rate of 18¼ miles an hour. I believe it is not at all improbable that this screw could be made to revolve more than 1000 revolutions in a minute. Being enclosed in a tube, the waves of the sea could not interfere with its velocity, and its motion would be continually even and regular; consequently the engine could suffer no injury from the unequal motion of the propeller as when it is exposed to the force of the waves, which must necessarily be a very great impediment to the progress of the propeller, and in some instances render it quite inoperative.

I am, Sir,

Your obedient servant,

L. GACHET.

Coggeshall, Essex, Nov. 27th, 1845.

LIGHT AND ELECTRICITY—PROFESSOR FARADAY'S DISCOVERIES.

At a meeting of the Royal Society, held on the 27th of November, a paper by Mr. Faraday, "On the Magnetisation of Light, and the Illumination of Magnetic Lines of Force," was read.

For a long time past the author had felt a strong persuasion, derived from philosophical considerations, that among the several powers of nature which in their various forms of operation on matter, produce different classes of effects, there exists an intimate relation; that they are connected by a common origin, have a reciprocal dependence on one another, and are capable, under certain conditions, of being converted the one into the other. Already have electricity and magnetism afforded evidence of this mutual convertibility; and, in extending his views to a wider sphere, the author became convinced that these powers must have relations with light also. Until lately his endeavours to detect these relations were unsuccessful; but at length, on instituting a more searching interrogation of nature, he arrived at the discovery recorded in his paper, namely, that a ray of light may be electrified and magnetized, and that lines of magnetic force may be rendered luminous.

The fundamental experiment revealing this new and important fact, which establishes a link of connexion between the great departments of nature is the following:—A ray of light issuing from an argand lamp is first polarized in the horizontal plane by reflection from a glass mirror, and then made to pass for a certain space through glass composed of silicated borate of lead, on its emergence from which it is viewed through a Nichol's eyepiece, capable of revolving on a horizon-

tal axis, so as to interrupt the ray, or allow it to be transmitted alternately, in the different phases of its revolution. The glass through which the ray passes, and which the author terms the dimagnetic, is placed between the two poles of a powerful electro-magnet arranged in such a position as that the line of magnetic forces resulting from their combined action shall coincide with, or differ but little from, the course of the ray in its passage through the glass. It was then found that if the eyepiece had been so turned as to render the ray visible to the observer looking through the eyepiece before the electric current had been established, it becomes visible whenever, by the completion of the circuit, the magnetic force is in operation; but instantly becomes again invisible on the cessation of that force by the interruption of the circuit. Further investigation showed that the magnetic action caused the plane of polarization of the polarized ray to rotate; for the ray was again rendered visible by turning the eyepiece to a certain extent; and that the direction of the rotation impressed upon the ray when the magnetic influence was issuing from the south pole, and proceeding in the same direction as the polarized ray, was righthanded, or similar to that of the motion of the hands of a watch, as estimated by an observer at the eyepiece. The direction in which the rotation takes place will, of course, be reversed by reversing either the course of the ray or the poles of the magnet. Hence it follows that the polarized ray is made to rotate in the same direction as the currents of positive electricity are circulating, both in the helices composing the electro-magnet, and also as the hypothetical currents which, according to Ampère's theory, circulate in the substance of a steel magnet. The rotary action was found to be always directly proportional to the intensity of the magnetic force, but not to that of the electric current; and also to be proportional to the length of that portion of the ray which receives the influence. The interposition of substances which occasion no disturbance of the magnetic forces produced no change in these effects. Magnets consisting only of electric helices acted with less power than when armed with iron, and in which magnetic action was consequently more strongly developed.

The author pursues the enquiry by varying in a great number of ways the circumstances in which this newly discovered influence is exerted; and finds that the modifications thus introduced in the results are all explicable by reference to the general law above stated. Thus the effect is produced, though in a less degree, when the polarized ray is subjected to the action of an ordinary magnet, instead of one that derives its power from a voltaic current; and it is also weaker when a single pole only is employed. It is, on the other hand, increased by the addition of a hollow cylinder of iron, placed within the helix, the polarized ray traversing its axis being then acted upon with great energy. Helices act with equal power in any part of the cylindric space which they enclose. The heavy glass used in these experiments was found to possess in itself no specific magneto-inductive action.

Different media differ extremely in the degree in which they are capable of exerting the rotary power over a polarized ray of light. It is a power which has no apparent relation to the other physical properties, whether chemical or mechanical, of these bodies. Yet, however it may differ in its degree, it is always the same in kind; the rotation it effects is invariably in one direction; dependent, however, on the direction of the ray and of the magnetic force. In this respect it differs essentially from the rotary power naturally possessed by many bodies, such as quartz, sugar, oil of turpentine, &c., which exhibit the phenomena of circular polarization; for in some of those the rotation takes place to the right, and in others to the left. When, therefore, such substances are employed as dimagnetics, the natural and the superinduced powers tend to produce either the same or opposite rotations; and the resulting effects are modified according as they are cumulative in the former case, and differential in the latter.

In the concluding section of the paper the author enters into general considerations on the nature of the newly-discovered power of electricity and magnetism over light, and remarks that all these powers possess in common a duality of character which constitutes them a peculiar class, and affords an opening, which before was wanting, for the application of these powers to the investigation of this and other radiant agencies. The phenomena thus brought to light confirm the views entertained by the author relative to the constitution of matter as being spheres of power, for the operation of which the conception of a solid nucleus is not necessary; and leads to the presumption that the influence of magnetism on bodies which exhibit no magnetic properties consists in producing in them a state of electric tension tending to a current; while on iron, nickel, and other bodies susceptible of magnetism, currents are actually established by the same influence.

RECENT AMERICAN PATENTS.

[From Mr. Keller's Abstracts in the *Franklin Journal.*]

IMPROVEMENTS IN THE PRINTING PRESS. *John L. Kingsley.*—The patentee says—" In my improved press the inking apparatus, and that for making the impression, are in their general construction, similar to those employed in the most improved machines, but they are so modified and arranged as to adapt them to an entirely new apparatus for conveying the sheet to the required positions for printing them on both sides, or what is technically called perfecting the sheets; which is done before the sheets leave the gripper, by which they are deposited correctly in a pile ready for drying. By this arrangement, one person is required to feed the machine by supplying the sheets to be printed, the press being actuated by any adequate power.

" In a machine thus arranged, one half the labour of feeding required in the best registering machine with which I am acquainted, namely, that of Tuft's of Boston, is saved, and with the employment of two persons at the feeding board; his press affords only about six hundred impressions in an hour, whilst, as my machine takes two impressions to one sheet supplied, and the printed sheet is deposited without interfering with the feeder or feeding, it may be run at any speed which allows time merely for the inking and the supply of sheets, and may consequently make from twenty to twenty-five hundred impressions in an hour. My machine secures a perfect register, as the sheet which has been fed in the gripper does not leave them until it is perfected, when it is deposited as hereinafter described."

Claim.—" What I claim therein as new, is the arrangement of the grippers combined with the carrying belts, by which I am enabled to carry in the paper, hold it, and retain it until it is perfected, by which it prints it on both sides and then deposits it; the operations being effected by so combining the sheet apparatus with the inking rollers as to give the carrying belts and grippers an intermitting progressive movement, as described.

" I also claim in combination with the printing apparatus, the so arranging of the carrying belts as to return the sheets of paper which have been printed on one side at nearly the same level which they occupied when they received the first impression, they being in both cases at the proper elevation for giving the impression as described.

" I claim, likewise, the manner in which the grippers are made to open and close by means of a spring operating to force and hold them open, and bolts for holding them when closed, in combination with the closer and opener, substantially as set forth."

MACHINE FOR BACKING BOOKS, FOR BOOKBINDERS. *William Laighton.*—The patentee says—" The operation of backing consists in giving that roundness or convexity to the back of the book which is necessary to prepare it for the reception of the covering of leather or other material. This process is usually performed by confining the book after it has been stitched and cut, between suitable boards or plates of metal, which are pressed firmly together by means of screws, and the back is then hammered into the desired form. In my machine, the book to be backed is confined between two plates, or jaws of iron, which are made to clasp it firmly, as if between the jaws of a vice, and these plates are so arranged as when closed to constitute a carriage, which, by means of a rack and pinion, is moved on in a straight line, so as to bring the back of the book against a roller, or against a block of iron, or other metal; when a roller is used it is made hollowing or concave on its periphery, and is so adjusted as to force the back of the book to assume the desired convex form, leaving it perfectly straight from end to end, and giving to it an equal convexity in all its parts. When, instead of the concave roller above named, I use a block of iron or other metal, which is made to occupy the place of the roller, the said block has that side of it which is towards the back of the book made concave, or hollowing lengthwise, and the back of the book as it is passed along being made to press against the block, receives the desired form; this latter manner of forming the instrument possesses some advantages over the roller, and will probably be generally preferred.

Claim.—" What I claim therein as new, is the manner herein described of causing the back of such books to be carried along against a fluted roller, or block of metal, whilst they are confined between the jaws of what I have herein denominated the backing irons, the respective parts of the said machine being arranged and operating substantially as herein fully made known."

APPARATUS FOR WORKING A VERTICA[L] FORGE HAMMER. *George E. Sellers.*—The essential feature of this invention is, f[or] working the hammer by means of tw[o] rollers, that receive motion from a stea[m] engine, or other motive force, one of whic[h] has its bearings in permanent, and the oth[er] in moveable boxes connected with a toggl[e] joint or other lever, so arranged as to forc[e] this roller towards the other, and gripe

square rod on the hammer to lift, and then separate them to liberate it—the toggle joint lever being connected with the roller by means of a powerful spring; and the mechanism that operates the toggle so arranged as to enable the attendant to regulate the play of the hammer at his discretion, to strike a light or heavy blow, as the condition of the iron may require.

Claim.—" What I claim as new, is the manner of operating upon the lifting rod by means of the friction drums, one of which is made to advance to, and to recede therefrom, by being placed on a sliding frame which is operated upon by a toggle joint, under an arrangement of parts substantially the same with that herein described. I also claim the manner of arranging the respective levers, the catch, the cam wheels, and their appendages, so as to be operated upon by the lines and chains attached to the said levers, substantially as described."

Buckle for connecting Straps. *Kasson Frashure.*—This buckle fastens the straps together without a tongue, and is called by the patentee the " Angular Box and Grooved Roller Buckle." The lower plate, which is attached to one of the straps, forms with the upper one an angle, so that at one end they are nearer together than at the other ; this constitutes what is termed in the specification the angular box. The upper surface of the lower plate of this box is grooved, and on it runs a grooved roller, the grooves of each fitting into each other like cogs. The strap to be fastened is passed between the top plate of the angular box and this roller, so that the more the strap is pulled the tighter it is squeezed by the turning of the roller against the upper plate. The angular box is provided with the requisite loops for retaining the straps in their proper directions. The roller is connected with the lower grooved plate of the angular box, by a strap which embraces the middle part of the roller, reduced in size for that purpose, and passes down through a slot in the plate and is there provided with a plate.

Improvement in Buckles or Apparatus for connecting Straps. *Charles F. Beverley.*—This differs from the preceding only in the use of a lever for the roller, so arranged, that, as the part which bears upon the strap, and which is notched for that purpose, is drawn forward by the strap, a catch on the upper surface of the lever is received in a lower tooth of an inclined rack attached to the grooved bottom plate, and thus the lever is caused to gripe the strap the tighter.

Composition of Matter for Lubricating the Rubbing Surfaces of Machinery. *Increase S. Hill and Joseph Dixon.*—The patentees say, " Our composition consists chiefly of zink, (which as is well known belongs to the class of cheaper metals,) hardened by being compounded with what we denominate a hardening composition.

" This latter composition is formed of the following metals, mixed in a state of fusion in the proportions hereinafter specified, viz. fifteen parts of tin to thirty-five parts of copper.

" This composition in a state of fusion is to be mixed with molten zink and tin, (although tin is not absolutely essential) in the proportion of the two parts of the said hardening composition, of nineteen parts of zink, and from three to five parts of tin, according to the peculiar purpose for which this composition is to be used, the tin specified to be added last, having the tendency to render the compound when cold more or less ductile, according to the quantity of the same incorporated therewith. The metal formed without the addition of the last named proportion of tin, when broken, will have the appearance of cast steel, of coarse quality, but the addition of tin will make it stronger, and cause it to be finer in grain until four parts of the same will be added, when the appearance of the metal, on its being broken, will resemble the finest cast steel, and more closely resemble the same than any other metal.

" The great strength of the composition, combined with a certain degree of softness which it possesses, renders it highly useful in the construction of bearings for rubbing surfaces of machinery, as it is capable of resisting for a great length of time, the effects of wear and attrition. The large proportion of zink used in forming the compound renders its use in the mechanical arts much less expensive than the metal ordinarily employed for these purposes, the cost being much less than any other composition in which copper and tin are the principal metals."

Improvements in the Syphon for Transferring Liquids. *George Johnson.*—The first improvement claimed is for charging single or double syphons by means of a bulb connected with the upper part or bend of the syphon, the bulb being of sufficient capacity to contain as much water as will fill the syphon. The second improvement claimed is for shielding syphons against reaction when one leg is to be used in warm water, by means of a shield or sleeve surrounding the leg of the syphon. And the third improvement claimed is for the manner of combining the bulb with a double syphon by means of a tube passing from the inner syphon through the neck of the bulb which is of sufficient capacity to form the communication with the outer syphon around this tube.

THE CONSTRUCTION OF RETAINING WALLS AND DRAINAGE OF EARTH WORK.

[Abstract of a Paper read before the Institution of Civil Engineers. By Thomas Hughes, Esq., C.E., with Discussion thereon.]

The object of this paper was stated to be not to enter upon the causes of slips, but to give a description of the employment of Watson's drain pipes, and of their application to two railway banks, in the neighbourhood of London.

These pipes are made with numerous apertures, which are small externally, and enlarge inwardly. *See Mech. Mag.* vol. xli. p. 336. Apertures of this form are not liable to become clogged; for the sides, being cut away, allow whatever enters to pass freely into the pipe. Without apertures, no pipes can be of much use in draining, though they may serve to convey away any water that happen to enter them by the joints; and common apertures are so soon choked, that they are of little use.

It had not been thought desirable to make these drain pipes of common clay, since, at a trifling extra expense, they can be made of the iron-stone clay, which abounds in Staffordshire and is acknowledged to be of very superior strength and durability. The pipes are also made with sockets, and are thus safe from the risk of displacement.

In March, 1844, Mr. C. H. Gregory, the resident engineer of the London and Croydon Railway, permitted an experiment to be tried upon a piece of bank, selected as the worst part of the line. The spot chosen was near the Sydenham station, at the side of the up-line. The mode of proceeding was as follows:—A longitudinal trench, 4 feet deep, was dug on the crown of the bank, at a few feet from the edge; and other trenches, about 30 feet apart, descended from it to the open drain, by the side of the permanent way. The drain pipes were then laid in, and the clay, which had been dug out of the trenches, was laid over the pipes. As great advantage is, in such cases, to be expected from ventilation, an occasional upright pipe rises from the longitudinal line of pipes to the surface. An interval of dry weather causes the soil round the pipes to crack in every direction, and thus opens numerous fissures for the passage of water to the drain pipes. This is particularly the case with clay; which, though generally presumed to be unfavourable for drainage, is, in this way, as easily managed as any other soil. This may be readily tested by exposing clay, which has not been manipulated, to a drying atmosphere for a few hours.

This piece of bank has not slipped since it was drained; but, as it is only 120 feet in length, and 20 feet in height, it is wished more particularly to call attention to a bank, a quarter of a mile in length, and rising upwards of 60 feet in height, having higher ground behind it. This bank is on the down-side of the line, between Chalk Farm bridge and Primrose Hill tunnel, near the London terminus of the London and Birmingham Railway. It was in a very precarious state, when placed in the hands of the author, in June, 1844. The soil was the London clay, and the trenches to receive the pipes varied in depth from 3 feet to 6 feet; the workmen being guided in this respect by the appearance of the ground as it was opened. The descending trenches were cut about 80 feet apart. The work has proved very satisfactory, and no repairs have been required since it was finished.

It was contracted for at 200*l*., and, as the length of pipe laid was 2,600 feet, it is at the rate of 1*s*. 6*d*. per foot, including every charge.

The author expects that this method will be found much more efficacious than either bush or stone draining, as such drains soon become clogged in heavy land, and never can possess the advantage of a circulation of air.

It will be recollected, that the close of the autumn of 1844 was extremely wet, and, as this work was executed in June, it has been well tried.

Retaining walls are frequently found to suffer severely from want of drainage, and, perhaps, no one more so than that of the Euston incline, London and Birmingham Railway. The application of these drain pipes was permitted on part of this wall, and every facility was given to the undertaking by the resident and consulting engineers.

It was necessary to bore through the wall, and several feet behind it, in order to insert the pipes; which, for this purpose, were made of cast iron, in lengths of four feet each, and were about 3 inches diameter. Boring through the wall was accomplished by a machine (which will be described on a future occasion); and, at some spots, cor siderable quantities of water issued instantly but, in other places, no water appeared f several days, or until rain had fallen; a some of these borings were observed to d up wet places, which showed in the wall the distance of several feet. This result w expected, from the admission of air causi the earth to dry, and to crack, all round t pipes; thus opening channels for the admi sion of water into them; and, after a hea

rain, all the borings may be seen to yield water. This relieves the wall from the considerable pressure which would otherwise, in time, have caused its destruction.

In boring through the wall, it was found that the bricks, which had been placed in contact with the wet soil, had become soft and decayed; but these bricks (or rather the portions of them brought out by the boring tool) were found to become hard again, when they had been exposed to the air for a few days

Three portions of the wall were thus drained in March, 1843, by making three borings in each panel. The success of this first attempt was not quite apparent; but Mr. R. Stephenson having approved of a further trial, with five borings in each panel, the result was so satisfactory that thirty more were thus drained, between October and December, 1843. These drains have therefore been more than a year in action; and it is worth noticing that several of them yielded water freely throughout the drought of 1844. The good effect upon that portion of the wall is very plain; though since the mortar has been washed out in many places, it would hardly be expected that the success should be so complete as it is. This may be attributed to the borings having been made 16 feet deep inwards, and thus collecting the water before it reaches the wall.

The panels operated upon in this way are 25 feet in height, and 20 feet in width. Each of them contains five borings; but in a more favourable soil, a less number would suffice. The charge for the work, including every expense, was 3*s.* 6*d.* per foot for the length of the drain pipe inserted.

Upon the occasion of part of this wall being rebuilt, two panels had the drain pipes inserted during the erection, and the result appears very satisfactory. In the retaining walls lately commenced on the Croydon Railway, they are being built in during the work. These are the iron-stone clay pipes. The author is of opinion that, in such cases, it is not safe to be content with merely building them in the wall, but they must also extend several feet behind it.

Mr. Dockray said, that previous to the insertion of the drain pipes, the walls of the Euston incline appeared to be saturated with water; but that they were now drying fast, and the water no longer settled behind them, being discharged by the pipes as fast as it percolated through the backing.

The slope of the cutting near the Chalk Farm bridge showed a tendency to slip, but the insertion of the pipes appeared, by draining the bank, to have stopped all movement of the soil.

Mr. R. Stephenson said, that the retaining walls of the Euston incline, were instructive examples of the discrepancy between theory and practice under peculiar circumstances. They were designed several years since, before he had attained his present experience of the effects of the action of the London clay.

The usual theory for the amount of pressure against retaining walls was that of Prony,* which might be stated to be, that the pressure was equal to the weight of a prism of earth, slipping upon the face of the natural slope due to the character of the soil.

This theory held good as long as the soil was dry, but when it became, as in the London clay, saturated with water, the position was no longer the same, and the pressure was that due to a column of dense semifluid acting upon the back of the wall. In this particular case the inclination of the strata required to be considered, to account for what had occurred. The wall had been forced forward at the spot where, in plan, it formed a considerable curve, thus appearing to oppose the convex surface of the back of the wall to the pressure; while on the other side, where the back was concave, the wall did not stir. On examination it was found, that from the inclination of the strata, the water percolating through the fissures accumulated against the convex back of the wall, reduced the clay to a semifluid state, and increasing its mobility, reducing the cohesion, until it forced forward the foot of the retaining wall, while the opposite wall, which would have been supposed to be weaker, remained firm; evidently because the inclination of the strata acted as natural drainage. The walls were 18 feet high, they were originally built 5 feet in thickness, but had been increased on rebuilding to 6 feet thick, and their foundations were sunk 5 feet deep below the surface, still they were forced bodily forward. It was natural to attribute the failure to the pressure of a dense semifluid, of a weight due to the altitude of the wall. The drain-pipes had acted well in drawing off the water, but fearing that they might not prove sufficient in a long duration of wet wheather, the cast iron truss beams were thrown across in order to lend the support of the lower and drier side to the upper side, which was more exposed to injury from the percolated water.

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* Vide 'Architecture Hydraulique,' tome i., pp. 288, 289; also, Hutton's 'Mathematics,' prop. xlv., vol. ii., p. 201.

Mr. STEPHENSON thought that retaining walls should be built nearly parallel from the bottom upwards. That was the practice of the late Mr. Rennie, and was well exemplified in the walls of the Sheerness-dock. He allowed ⅛th of the height for the batter of the face, and ⅛th for the thickness. Whether the thrust of the earth was opposed by a wall with a straight or a curved batter, an equally effective resistance was obtained, with a less quantity of material than in a wall with a vertical back and an inclined face; but the curved form was more convenient for dock walls, and was more elegant in appearance. The whole question of retaining walls might be reduced to the simple mechanical principle of the lever and the inclined plane, indicated by the angle of repose of the soil, which the wall was intended to resist, due allowance being made for an increase of its natural density from the absorption of water.

Sir JOHN RENNIE, in reviewing shortly the interesting remarks of Mr. Stephenson, induced by the discussion, referred to some troublesome works executed by the late Mr. Rennie, on the old Croydon canal, where the London clay had caused many difficulties at that period, as it had done recently in the New Cross cutting of the railway. Mr. Rennie succeeded, by carefully intersecting the crevices and by copious drainage, in diminishing the evil and preventing the extension of the slips. An elaborate report had been made on the subject which he promised to present to the institution on a future occasion.

WEAR OF RAILWAY IRON.

From the *Boston* (*U. S.*) *Courier*.

There has been a great deal of discussion and speculation during the last two years, as to the probable duration of railroad iron when exposed to a heavy traffic; and there are few subjects on which the opinions of practical men have differed more.

We have, however, at last, the means of forming a very safe estimate of the durability of a 56lb. to the yard edge rail, when well laid, on an even and well-adjusted track.

The first ten miles of the second track of the Lowell-road was first brought into use in 1838, after the "fish-belly rail" had been found inadequate. The new rail was of the H pattern—the form now most generally approved.

The following table shows the number of tons which passed over the road, in each year, from 1838, when this rail was first used, until July 1845, when the company commenced making extensive repairs:

In 1838, about	60,000	tons.
1839, ...	70,000	"
1840, ...	73,000	"
1841, ...	86,000	"
1842, ...	91,000	"
1843, ...	115,000	"
1844, ...	150,000	"
1845, (to July)	75,000	"
Total freight ...	720,000	
In addition to this quantity there has been transported, annually, about 16,000 tons of passengers and baggage, or in seven and a half years	120,000	
Making the aggregate tonnage about	840,000	

One *half* of this quantity only has passed over the second track; which, up to this time, therefore, has sustained 420,000 tons. The question is now, what effect has this tonnage produced? Is the rail visibly injured by it?

The company have relieved us of the necessity of all speculation on this point, by taking up several considerable stretches of this rail in 1844; and they are *now* making still farther changes—one about *a mile long* near the three-mile stone, and the other about *half a mile*, near South Woburn. They will be compelled to make additional renewals this year, and probably to change the iron on the whole of this ten miles in the next year. The durability of this rail may, therefore, be set down at 500,000 tons. The lowest estimate we have ever seen of the power of a good edge rail is 1,000,000 tons.

In 1841 and 1842, the Lowell company took up 26 miles of the "fish-belly" rail, and laid down a new iron of about 56lb. per yard; some portion of it was 60lb., and that which they are now using is 63lb. iron per yard. This change of iron cost 121,559 dollars, after deducting the proceeds of the old iron, or about 4,700 dollars per mile.

The new iron was heavier than the old, which, of course, increased the cost of making the change; but, on the other hand, the new iron was purchased while railroad iron was admitted free of duty, which *reduced* the cost.

If we make the proper allowance for these two circumstances, we shall find that the cost of taking up one track of 56lb. iron, and replacing it by a new track of the same weight, is very nearly 5,000 dollars per mile.

If we then divide this sum by 500,000 tons, the amount of trade which will have destroyed it, we have obtain *one cent. per ton per mile* for the value of the wear of iron on this road. This is a larger result than we should have looked for; but as the company receive more than *five cents per mile per ton* for all the freight they carry, they can afford to renew their iron and still make reasonable profits.

PATENT LAW.—A NICE POINT.

Elliott v. Turners.

Writ of Error. Exchequer Chambers, Westminster Hall, 25*th Nov*, 1845.

This case was argued on the 16th of June, 1845, by Mr. Montague Smith on behalf of Mr. Elliott, and Sir Thomas Wilde on behalf of Messrs. Turners.—The Court took time to consider its judgment, and Mr. Baron Parke now gave judgment as follows:

The question in this case arises upon an exception to the direction of my brother Coltman in an action tried before him upon a covenant by the defendants to pay to the plaintiff, a patentee, a stipulated allowance for all the buttons made by the defendants according to the plaintiff's patent, pursuant to a license. The issue was, whether certain buttons made by the defendants, called "Italian Twist Dress Buttons," were made under the license to use the plaintiff's patent.

The parts of the specification which were material to this question were these:—"The third head of my invention being the application of such fabrics only wherein the ground or face of the ground thereof is produced by a warp of soft or organzine silk, such as is used in weaving satin, and the class of fabrics produced therefrom;" and afterward, in another part, the plaintiff states that his claim is to the application of such figured woven fabrics to the covering of buttons with flexible shanks made by pressure in dies as have the ground or face of the ground woven with soft or organzine silk for the warp, where such fabrics have ornamental designs for the centre of the buttons.

On the trial much evidence was given on both sides—the witnesses for the plantiff stating that the buttons of the defendants were made of organzine silk; those for the defendants, that they were not; but the latter deposed that they were made of a material called twist, which might be termed soft silk, organzine being a species of silk thread in which there was a spin or twist on each of the threads before they were twisted together — twist in which two or more threads were twisted together, each thread not having been twisted.

The Learned Judge summed up the evidence to the jury on both sides, leaving to them the question whether the buttons made by the defendants were made of soft or organzine silk, within the meaning of that part of the specification.

At the close of the summing up, the Foreman of the Jury said, it would much assist the jury if the learned Judge would tell them how they were to interpret the word "or" in the specification—whether it was disjunctive, or whether "*organzine*" was the construction of the word "*soft*"—and thereupon the learned Judge gave it as his opinion, that "unless the silk was organzine it was not within the patent;" and the Counsel for the plaintiff excepted to that opinion, and insisted that soft silk, though not organzine, was within the patent and license.

We are *all** of opinion that the exception was well founded, and that the direction of the learned Judge was not correct.

The word "*or*," in its ordinary and proper sense, is a disjunctive particle, and the meaning of the term soft *or* organzine, is properly either one or the other—and so it ought to be construed, unless there be something in the context to give it a different meaning, or unless the facts properly in evidence, and with reference to which the patent may be construed, should show that a different interpretation ought to be made.

There was nothing in the context to lead to a different construction, but the facts might be such, that applying the patent to them, the word "or" ought to be construed, not in its proper sense, but as another description of the same thing; and the words read as if they had been soft, *otherwise called* organzine silk.

And if the fact was, that at the date of the patent organzine was the only species of soft silk in known use in manufacturing satin, that would be a sufficient ground for construing the specification which applies to such soft or organzine silk as was then used in weaving, to mean to apply to soft, *alias* organzine silk, and include organzine only; but if there was soft silk as well as organzine used at that time, then the specification must be construed in its proper sense, and both species would be within the patent.

The interpretation, therefore, which the learned Judge put upon the patent was not correct, unless the facts were such as to lead to it, and those facts were for the determination of the jury, and the learned judge should not have told the jury, absolutely, that soft and organzine silk were the same, but that the word was capable of being so construed, if the jury were satisfied that at the date of the patent there was only one description of soft silk, and that organzine, used in satin weaving, but otherwise that the

* The argument. on the 16th of June, was heard before Mr. Baron Parke, Mr. Baron Alderson, Mr. Justice Patteson, Mr. Justice Williams, Mr. Justice Coleridge, Mr. Baron Rolfe, Mr. Justice Wightman, and Mr. Baron Platt.

proper and ordinary sense of the words was to be adopted, and the patent held to apply to every species of soft as well as to organzine silk.

It was argued that the learned Judge's observation must be understood in connection with the evidence, and that it proved the fact that organzine was the only known species of soft silk used in weaving satin at the date of the patent; but the answer is, that the Bill of Exceptions states the evidence only; none of the facts are found by the jury, and none of them can be assumed to be true—and, as the construction depended on the facts, the question should have been left to the jury as to the truth of those facts.

Therefore there must be a *venire de novo*.

NOTES AND NOTICES.

Steam Navigation in the United States.—The *Hendrick Hudson*, steamer, performed the distance, recently, from New York to Albany, 160 miles, in 7 hours 40 minutes. She ran part of the distance at the rate of 24 miles an hour. The average speed of the *Oregon*, the new boat built at New York, is 23 miles to the hour, and even that it is intended shall be eclipsed by the *Iron Witch*, now nearly ready to commence her trips between New York and Albany. The *Witch* is entirely of iron, and is 225 feet in length. Her machinery is of entirely new construction—the invention of Mr. Ericsson—and is all placed below the deck. She will not require the usual smoke-pipes, as the smoke, as well as the heat will be consumed. Her engines will have more power than those used on board of steam boats of the larger class, and she is to draw less water! She will have two magnificent saloons, extending from stem to stern; and, when completed, she will not resemble a steam-boat, but an elegant pleasure barge. Mr. Ericsson—under whose direction the *Iron Witch* has been built—has "stipulated" that she will beat the *Empire*—one of the swiftest boats on the Hudson—five miles an hour! We must not omit to mention, that, notwithstanding the great speed of the boat, she will require only one-third of the amount of fuel consumed by the *Empire*. Coal is to be burnt.—*New York Mirror.*

New Life Boat.—At a public meeting of ship-owners lately held at the Exchange-buildings, Sunderland, for the purpose of hearing full particulars, and seeing the models of a new life boat, for which Mr. Reginald Orton, of that town, has recently obtained a patent; R. Scurfield, Esq., presided, and, after a long discussion, it was resolved to appropriate 60*l.* towards the erection of the first boat on the new plan, which promises to obviate the deficiencies of the life boats now in use, and to be of essential service to the community by the saving of human life. The leading features of this invention may be thus described: at each end of the boat are two air cases, and on each side metal cylinders 12 inches in diameter. These end cases and lateral cylinders are cased with wood, which thus forms at the same time the external facing of the boat, and a protection to the cases and cylinders. Extending across the boat are six thwarts, which also perform the double duty of strengthening the boat and increasing its buoyancy, by their under surface resting on the water. The thwarts are closed by strips of wood, and the open space in the centre is filled by a trough, extending from end to end, with a metal grating beneath. The mode of propulsion is by paddles, which do not hold the wind, are not liable to be struck by the sea, and thrown off the thole-pin, and are not in the way in approaching a wreck. The advantages of the boat are stated to be her lightness, which enables eight men to launch her; the smallness of her crew, eight men being only necessary; her presenting so small a surface for the action of the wind or sea, that she cannot, under ordinary circumstances, be upset, and if upset, must right herself; and the circumstance that if from any emergency she should be kept bottom up, she is still a safe boat, as there is a free supply of air to those within her through the grating of the well, and from those who might be thrown out are ample means of getting on the bottom till saved or drifted ashore. Her buoyancy is such that she is capable of floating, breast high, upwards of 300 men, although she could not operate as an efficient boat with that number clinging around her.—*Tyne Mercury.*

Unparalleled feat of Swimming.—In the report of a dinner lately given at Yarmouth, to the beachmen and crews of several life-boats upon that dangerous coast, appears the following passage:—"The chair was occupied by John Barnes, who fought with Nelson at the battle of the Nile, supported on the right by Samuel Brock, the dauntless beachman, who was miraculously preserved from shipwreck on the 6th of October, 1835, *and swam a distance of nearly fifteen miles*, after being seven hours and a half in the water. He, with his companions left the beach to assist a vessel in distress, which proved to be the Spanish brig *Pagnella de Bilboa*, from Hamburgh to Cadiz, but their yawl was upset in a sudden squall, and all his brave companions were immersed, and perished before his eyes."—*Norwich Mercury.*

The late Lunar Eclipse as seen in Paris.—The eclipse of the moon on the 13th instant could be observed (says a Paris print,) with a facility that could hardly have been hoped for after the wretched weather that had prevailed during the day. The moon was situated not far from the planet Jupiter, in that portion of the heavens in which the most brilliant constellations are found, Taurus, Orion, Castor and Pollux. Shortly after ten o'clock P.M., our satellite, then in the penumbra, appeared to be enveloped in dusky vapours. At about twenty minutes past eleven, the disc began to be eclipsed in its southern limb; the shadow of the earth made a sensible progress, until 2 minutes before 1 o'clock on Friday morning. Eleven digits, that is to say, 11-12ths of the moon's surface were eclipsed, there only remaining a small segment of the circle unobscured; and as a slight mist had suddenly arisen, the part that remained visible, surrounded by a nebulous *auréole*, only shed an uncertain and feeble light. By degrees, the shadow of the earth passing over to other parts of the lunar disc, in a space of about an hour were seen in succession all the phases of the crescent, the first quarter, and the full moon. At twenty-seven minutes past two o'clock, the regular eclipse was over, but the vestiges of the penumbra remained till nearly three o'clock in the morning. The Parisians were, as usual, more fortunate than the Londoners. In London the moon was obscured by clouds, and the eclipse was only perceptible by the gloomy obscurity that prevailed as long as it lasted.

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1166.] SATURDAY, DECEMBER 13, 1845. [Price 3*d.*

Edited by J. C. Robertson, No. 166, Fleet-street.

THE CARCEL METEOR LAMP.

Fig. 1.

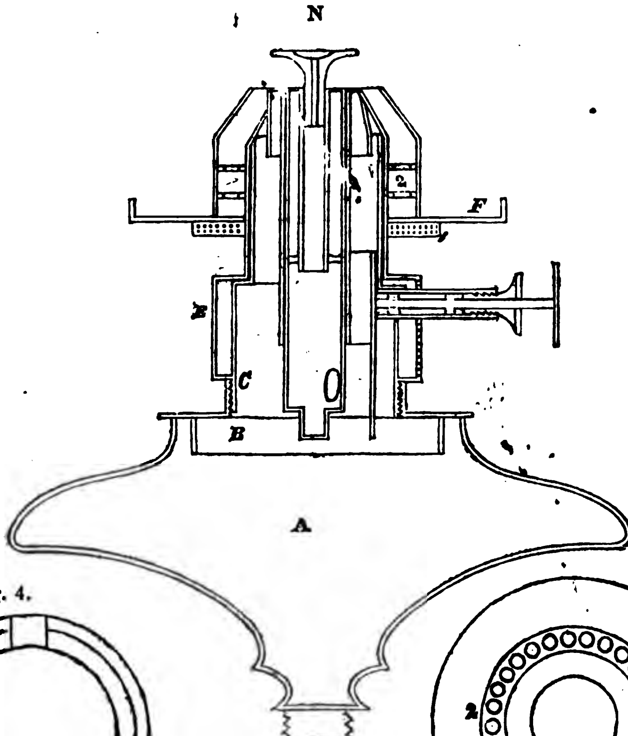


Fig. 4.

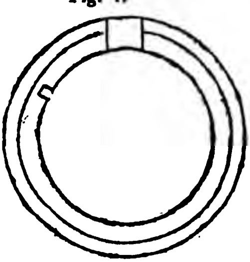


Fig. 6.

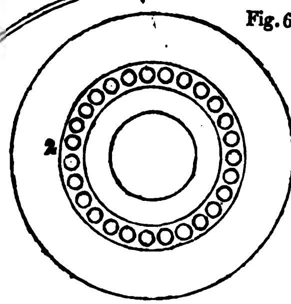


Fig. 2.

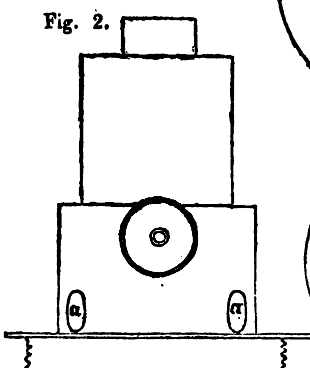


Fig. 3.

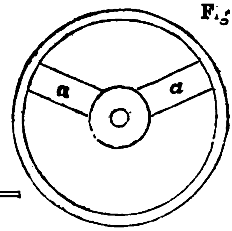
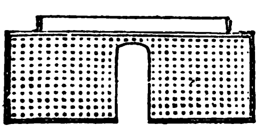


Fig. 5.



THE CARCEL METEOR LAMP.

Among the new lamps of the present winter season, one of the most deserving of notice is the improved Carcel Lamp, represented in the prefixed engravings. It is adapted to the burning of camphine and other spirits, and is chiefly distinguishable from other spirit lamps in the substitution for the ordinary solid breaker, of a hollow tube, with a cup-shaped top, through which a column of air is constantly supplied to the interior of the flame. By this simple, but very scientific contrivance, a light of much superior brilliancy is produced.

Fig. 1 represents a lateral section of this lamp. A is the reservoir; C the burner (shown separately in fig. 2) which is screwed into a collar B, fixed in the top of the reservoir. N is the new hollow breaker; *a a* are two air tubes, which are carried from the outside of the burner C in an angularly inclined direction to the inner air-tube D. A plan of this air tube, with its two feed-pipes, is shown separately in fig. 3. E is a wind guard of the peculiar form shown in plan and section in figs. 4 and 5. F is the glass holder, which consists of two parts, 1 and 2; the part 1 is perforated at bottom, and the part 2 encircled by perforated rings, as shown separately in the plan, fig. 6.

ON THE EMPLOYMENT OF A COLUMN OF WATER AS A MOTIVE POWER FOR PROPELLING MACHINERY. BY W. G. ARMSTRONG, ESQ., NEWCASTLE-UPON-TYNE.

[More than four years have elapsed since the author of this paper first drew public attention in the pages of this Journal (April 1840,) to the availability of the water supplies of cities and towns as sources of mechanical power, and at the same time, described a very simple and ingenious apparatus of his invention, by which any one having a descending column of water at his command, might turn it to excellent mechanical account. Nothing came of this suggestion at the time, but very recently a company has been projected in London under high auspices for supplying water at a high pressure for mechanical, as well as domestic purposes; and this has induced Mr. Armstrong to bring the matter before the Literary and Philosophical Society of the town where he resides, with the view, as well of asserting his just claim to be considered as the author of the new system which (it is to be hoped) is about to be adopted, as of still further developing and illustrating its capabilities. For the following very complete Report of a communication, partly written and partly verbal, made to the Society on Wednesday, the 3rd instant, by Mr. Armstrong, we are indebted to the *Newcastle Chronicle*. Ed. M. M.]

There is no circumstance which, in future ages, will reflect so much honour upon this country, as its having been the cradle, if not the birth-place, of the *steam engine*.

It is scarcely possible, at the present day, sufficiently to appreciate the powerful influence which that admirable invention is exercising, in elevating the condition, and promoting the happiness of mankind. It is carrying civilization to the remotest parts of the earth; it is bringing nations into friendly communication with each other; and it is dispensing all those articles of manufacture which are essential to refined and cultivated life, to millions of the human race who would otherwise be without them.

But although this greatest triumph of man's skill and ingenuity is entitled to the highest admiration, the brilliant results which have been accomplished by steam ought not to have diverted attention from other sources of motive power. While steam machinery has been advancing with rapid strides to its present wonderful state of perfection, the valuable agency of descending water as a means of propelling machinery has been almost wholly neglected, and few attempts have been made either to extend its operation beyond those places where natural falls of water are to be found, or to increase its efficiency by improving its mode of application.

But water power, although thus treated with neglect, is possessed of capabilities scarcely inferior to those of steam, and it shall be my endeavour this evening to

point out how wide a field exists for its employment, and to explain the means by which its efficacy may be increased.

The celebrated works constructed by Mr. Thom, in the neighbourhood of Greenock, have practically demonstrated the important proposition, that an enormous mechanical power may be realized, by collecting surface water in elevated situations, and causing it to act upon machinery, during its descent, in such a manner as to bring the entire fall into operation.

You will readily perceive, that if the vast quantities of water which pour down the brooks and water-courses of hilly countries in time of rain, were to be arrested in spacious ponds or reservoirs, formed in hollows, upon the elevated lands from which the water is discharged, and were subsequently to be let out by degrees, so as to increase the volume of the streams when the natural quantity of water should be deficient, the *transient* produce of useless floods would become available as a *permanent* source of mechanical power. I am supported by numerous facts and experiments in stating that hill side brooks and rivulets frequently run to waste in a single day, when flooded, as much water as they produce in three months of dry weather, and you may, therefore, conceive how enormously the available quantity of water would be increased by equalizing the fluctuating produce of such streams by means of catch ponds or reservoirs.

This principle has been carried out by Mr. Thom to the fullest extent, at the Greenock works. By throwing a barrier across a ravine, situated at an elevation of 500 feet above the level of the river Clyde, and traversed by a brook of inconsiderable magnitude, he has formed a lake or reservoir, which receives the whole of the water produced by the stream, as well during floods, as at ordinary periods. From this reservoir the water is discharged in a uniform stream, which, in its descent, falls over a series of water wheels, similar to that represented in this diagram (exhibiting one), but comprising a much greater number of wheels, and thus a collective power of no less than 2,000 horses has been obtained from a stream which was formerly deemed incapable of affording a twentieth part of that power.

You will observe, however, that the enormous mechanical power which has thus been brought into operation at Greenock, is attributed not only to the system of impounding surplus water, but also to the great elevation of the collecting reservoir. Water, in whatever way it be applied to machinery, is merely a descending weight, and, like any other gravitating body, its mechanical effect is proportionate to the height from which it descends.

But the overshot water wheel, although a simple and effective machine in many instances where nature, with little aid, has supplied the fall of water, is an extremely rude and imperfect contrivance for rendering available the power of water artificially supplied from great elevations. Where the power of a stream is brought into action by a series of water wheels, many of the wheels must necessarily be situated in places difficult of access, where power is comparatively of little value. In order, therefore, to realize, to the full extent, the advantages to be derived from the system of collecting water on elevated ground for mechanical purposes, a method is required of *concentrating* the power of a stream, and bringing it into action at the place most eligible for the establishment of mills and manufactories. It is also of importance that means should be provided of distributing the power to be thus obtained throughout a town, and apportioning it out to a manufacturing population, according to the extent of their wants, and without the intervention of cumbrous machinery. Water, if thus supplied as a motive power, would possess advantages greatly superior to those of steam for every purpose excepting locomotion, and localities favourable for the application of the system would, in all probability, become the sites of manufacturing towns.

I shall now, therefore, proceed to explain the methods by which I conceive these desirable objects might be obtained.

Suppose, then, in the first place, that instead of delivering water *in a stream* from a collecting reservoir, and passing it over a succession of water wheels, as practised at Greenock, *a pipe* were to be laid for the conveyance of the water from the reservoir to the foot of the descent. Suppose, further, that the column

of water contained in the pipe were caused to operate, *by its weight or pressure*, upon suitable machinery placed at its lowest extremity, we should then obtain, in the lowest and most valuable situation, the *concentrated effect* of the entire fall.

Then, in order to effect the distribution of that power, it would only be necessary to ramify the lower end of the pipe, so as to bring the pressure into operation at any number of points at which it should be required.

We have next to determine by what species of machine the pressure of the column of water could be most effectually brought into operation; but before I enter upon this part of the subject, I shall make a few observations, illustrated by experiment upon the nature and properties of hydraulic pressure.

[Mr. Armstrong here explained the action of a column of water, showing by experiments and diagrams, that the pressure it exerted upon a given area was proportionate to the vertical height of the column without reference to the size of the containing tube, and was the same whether the column was perpendicular or inclined, straight or irregular. And that although the amount of pressure which a column of given height would exert might be increased to any extent by enlarging the surface acted upon, yet that the expenditure of water was always proportionate to the effect produced, and further, that although the mere pressure upon a resisting surface was the same whether the supply pipe was large or small, yet, that in order to obtain a rapid motion, a large pipe must be used, more especially if the pipe were of great length, because the rapid flow of water which is inseparable from the use of a small pipe, gives rise to a great loss of power by the friction of the water against the interior surface of the pipe. Mr. Armstrong then explained the rotary water engine which was placed upon the table, and of which a full description may be found in the *Mechanics' Magazine* for April, 1840. He next proceeded to point out the advantages which would result from the principles of impounding surplus water and causing it to act as a column, by referring to a particular stream which afforded by no means a favourable example, but which he selected on account of its being familiarly known to every inhabitant of Newcastle, viz.: the Ouseburn, which flows into the Tyne immediately to the east of this town. Suppose, he said, that instead of having a succession of six mill races and six falls, as was the case on the Ouseburn, the first mill race were continued along the banks of the stream gradually getting higher and higher above the natural channel of the brook, to within a short distance of the Tyne, where a single fall of upwards of 100 feet might be obtained. Suppose, also, that the water were conveyed from this point by a pipe to any number of water-pressure engines situated in eligible situations on the margin of that river. Let it further be supposed, that large catch ponds for the reception of flood water were to be formed by throwing barriers across the valley above the present site of the highest mill. By these combined operations, we should not only enormously increase the available quantity of water, and the mechanical capability of the stream, but we should also bring its concentrated power into action on the margin of a navigable river, where power would be of infinitely greater value than where the mills are now necessarily situated. Mr. Armstrong then continued as follows:]

I do not mean to contend that in a locality like this, where the expense of fuel, and consequently of steam power are, relatively speaking, extremely small, that it would be expedient so to deal with the stream I have mentioned; but there are multitudes of situations where streams are to be found possessing far greater capabilities than the Ouseburn, and where, if I mistake not, important manufacturing towns will eventually spring up, when the mechanical agency of water collected and supplied in the manner I have described, shall be sufficiently appreciated.

Whittle Dean, for example, which has been so much canvassed of late in connexion with the new project for supplying this town and Gateshead with water, has a descent of 360 feet from the site of the proposed collecting reservoir, to the Tyne, and might be caused to yield, at the lowest point of its course, an amount of power which would appear incredible to those who either cannot, or will not understand how enormously the available produce of a stream may be augmented by means of accumulating reservoirs.

It may probably be said that streams of this character are most usually situated in remote and inconvenient situations; but to this it may be answered, that the water may generally be conveyed with little difficulty, in a duct or canal, to a considerable distance from the parent stream, before it is brought into operation. At Greenock the collecting reservoir is situated at a distance of nearly

seven miles from the mills, to which the water is conveyed by an aqueduct, which was constructed at a very moderate expense, and the same plan might be followed in other situations, wherever the nature of the ground is favourable for the purpose. It is also to be observed that the railway system, which is now making such rapid progress in this country, is daily diminishing the importance which has been hitherto attached to *situation*, and in all probability will ultimately render almost every valley in the country conveniently accessible for the purposes of trade and manufacture.

But even the water which is already supplied to towns for domestic and manufacturing uses, may in many cases be applied, with great economy and advantage, to various mechanical purposes, and there are few towns in England more favourably circumstanced for making the experiment than Newcastle, where the great altitude of the service reservoirs by which the town is already supplied, as well as of those which are about to be executed, offer peculiar inducements for such an employment of the water.

The obtainment of water of a suitable quality for household use, is usually attended with too much expense to permit of the same water being used mechanically on a large scale, as a substitute for steam; but as a substitute for manual labour, as applied to a numerous class of machines, which cannot be profitably worked by steam, it will be found a cheap and most convenient power.

Human labour is at once the most costly, and the least effective of all the motive powers that are applied to machinery, and yet, for want of a suitable substitute, men are daily employed, to a great extent, in all trading and manufacturing towns in no higher capacity than beasts of burden, for the mere purpose of producing motion, in cases where the exercise of skill and intelligence are wholly excluded.

Amongst the many examples that might be given of this kind of labour, I may mention the lifting of heavy goods into and out of ships and warehouses. The numerous ships, for instance, which frequent the quay of this town, are all loaded and unloaded by mere personal strength applied to cranes or other lifting machinery, the whole of which might be worked at much less expense, with far greater expedition, and consequently with much less detention to ships, by means of the pressure which exists in the street-water pipes, than by the present method.

In order to illustrate the practicability and advantage of such an application of the water by which this town is already supplied, I have had a model constructed which will enable me to explain the matter experimentally to you.

[Mr. Armstrong then described the model of the crane, which, so far as external appearances were concerned, was an exact representation of one of the cranes now used upon the quay, and which was adapted to show in contrast the present operation of lifting goods, and the proposed plan of raising them by the action of the water. The machine was put in action by a supply of water conveyed into the room, at a high pressure, by a lead pipe, and, although the sudden frost which had set in, unfortunately interfered with the temporary means of supply which had been provided, Mr. Armstrong was enabled to show, in a most satisfactory manner, the perfect precision of the machine—its great power and the important saving of time and expense which would result from its employment. The operations of lifting and lowering weights, and of turning the crane to either side, were all directed and controlled by the motion of a pointer upon an index plate. After describing this part of the apparatus, Mr. Armstrong removed a portion of the model which represented part of the quay of Newcastle, and exposed to view a vault or tunnel, which contained the machinery. This was of a very simple description, consisting of two horizontal pipes or pumps, equal in length to the maximum height to which goods were required to be lifted. When weights under two tons were to be raised, the chain was to be hooked on to the piston rod of the smaller pipe, which, in practice, with the pressure attainable on the quay, would require to be 6 or 7 inches in diameter. For greater weights, up to eight tons, the chain would be attached to the piston rod of the large pipe, which would be 12 or 14 inches in diameter. The water on entering either of the pipes, forced along the piston and pulled the chain, and on being allowed to escape, the piston returned and lowered the weight. A very simple adjustment of valves regulated the ingress and egress of the water, and determined the speed at which the weight was to be lifted or lowered. A small double-acting cylinder turned the crane, by pulling a chain coiled in opposite directions round its stem, below the surface of the ground, and by a very

simple arrangement the motion of the crane was rendered compatible with the other parts of the mechanism in being fixtures. Mr. Armstrong further showed that means were provided for preventing the abrupt stoppage of the water which might endanger the safety pipes, so that it was impossible for the most careless person to injure the apparatus; and he also stated that the cost of the water which would be expended in raising a given weight by the proposed plan, would be about one-third or one-fourth of the expense of raising a similar weight by the present method. Mr. A. concluded as follows:—]

The limits of a single lecture will not permit me to detail the particular modes in which hydraulic pressure from Town Water Works, such as we have in Newcastle, might be applied to other mechanical operations besides that which I have mentioned; but I am persuaded that the cases in which it might be profitably employed are exceedingly numerous. Its fitness for all kinds of machinery for lifting weights, whether with quick motions or slow, is easily shown, and it is my strong opinion that in small establishments of various kinds, where the quantity of work is insufficient to justify the erection and maintenance of a steam-engine, it would prove extremely valuable as a means of giving motion to lathes, printing-presses, machines for performing the operations of drilling, boring, and punching, planing and clipping metals, revolving saws, forge-hammers, and so forth, especially where such machines are only required to be in action, as is usually the case, at uncertain periods, and with frequent intervals of rest; for the power we are discussing has this admirable property which is not possessed by the steam-engine, viz., that it is always ready for action without occasioning expense except when in actual operation. Its application, therefore, to cranes, which I have illustrated by a model, must merely be regarded as a specimen of the capability of a system, which I hope and believe will gradually make its way in this and other towns, and eventually be productive of much public advantage.

The substitution of inanimate power for human labour must unfortunately always be attended, in the first instance, with the evil of depriving individuals of employment; but the general welfare of the community is unquestionably promoted in every instance in which we succeed in coercing insensible agents into our service, for the purpose of moving machinery. Man was designed to work by his head rather than by the mere strength of his arm, and as he continues to extend his dominion over the powers of nature, his occupations will gradually assume less of the physical and more of the intellectual character.

The employment of steam power on a large scale for the purpose of generating hydraulic pressure, to be diffused through a town for the propulsion of machinery, or to be exercised in mines for underground traction, are branches of the subject which I am compelled to postpone to some future occasion, and in conclusion, I shall merely observe, that an outline of the views to which I have this evening directed your attention, and which I have long entertained, on the subject of water power, may be found in a paper which I published in the *Mechanics' Magazine* for April, 1840. I am induced to refer to this paper, because I am informed that a company has recently been projected in London for supplying water at a high pressure, exclusively for mechanical purposes, and I naturally feel a disposition to assert my title to priority in the suggestion of the principle. I am quite unacquainted with the particulars of the scheme to which I allude, and although I fully believe that such projects will eventually succeed, I fear the time has scarcely yet arrived for carrying them into execution. It would be better to introduce the system by degrees, in conjunction with the supplying of water for domestic and other ordinary purposes, rather than than to run the risk of failure by attempting more than the age is ripe for.

MALLET AND NASMYTH.—ATMOSPHERIC RAILWAYS.

Sir,—I have no time for wrangling. Your lengthy correspondent seems to have plenty on his hands; to judge by the pains he has taken in your pages for November 29th, 1845, to try to show that some Mr. Carson is the meritorious first inventor of direct steam vacuum for use upon atmospheric railways, and not either Mr. Nasmyth or myself.

If Mr. Dircks had given the whole of Carson's specification, and not garbled his quotations by suppression, I would

have left him and the subject to find their proper level; but as most of your many readers will not have access to the specification of Carson in full, or not take the trouble to consider its bearing on the question of my invention, I must devote a few minutes, and pray permission to have a little of your space to set the matter right. The specification of Samuel Carson's patent, dated February 5th, 1840, will be found at length in the Repertory of Arts, vol. xv. p. 71, and I would beg of you, as a patent agent, and therefore one called upon to keep the public right upon questions of this sort, to print herewith the whole specification, and accompany it and the present with your own opinion as to how far I am right or not, in the following view.*

There is no question raised by Mr. Dircks as to my being an independent inventor, *i. e.*, he does not accuse me of plagiarism, but asserts that the invention of using the direct condensation of steam, after blowing out the air for obtaining vacuum, for use upon atmospheric railways, no matter by whom re-invented, was first invented, because patented, by Mr. Carson.

Now Carson's preamble to his specification states, that "his invention relates to certain apparatus for removing air from a chimney or other shaft, first, by means of draughts induced by means of the outer atmosphere, and secondly by means of steam;" and then, after describing a number of smoke-doctoring contrivances of chimney-pots and what not, he proceeds to state his three claims, which are: First, he claims the *mode of constructing apparatus for withdrawing air from a chimney or shaft*, as described in figs. 1. 2, &c, viz., the several chimney-pots or cowls. Secondly, *The apparatus described* in fig. 7, for withdrawing air by means of steam; and, lastly, The *mode of constructing apparatus* to be worked by steam and condensation, *as described* in respect to fig. 8.

Now, the title and preamble of a specification must agree with the claim. The one must not include more than the other.

It is plain that Carson's invention relates altogether to modes of ventilation or of curing smoky chimneys, (which I presume first drew Mr. Dircks' *professional* attention to it,) and that in no one sentence of his patent does he so much as hint at the use and intention of applying his apparatus to any other purpose, least of all to atmospheric railways, and that therefore he could be no inventor at all of anything relating to atmospheric railways, so far as his patent shows, either in a common, or in a technical sense.

This is what, therefore, the claim of his patent *is not* for,—but now then, what *is* it for?

His claim is limited simply to the particular apparatus, and mode of constructing the apparatus which he has figured and described, and as applied to the ends or uses to which he limits himself in the preamble of his patent; and this being so, his inventions have nothing whatever to do with those to which Nasmyth and myself lay claim.

For, assume this not to be so; let it be supposed, (as Mr. Dircks does,) that the patentee proposes to claim generally the use of blowing out and condensing steam by his apparatus to any purpose; then the patent itself, besides its internal technical defect of non-agreement of title, preamble, and claim, is null and void, because this mode of obtaining vacuum has long, long ago, been proposed, printed, and applied to a great variety of uses; for instance, Dr. Ure, in his Chemical Dictionary, (under the article *Caloric*, I think, but I quote from memory, and have not for years looked at the book,) recommends this mode of producing vacuum for formation of ice, according to Leslie's plan; and other persons have long since proposed its use for evaporating vegetable extracts, solutions of organic or other salts, &c.

Direct steam vacuum is therefore no novelty in itself since the days of Savery's engine—it is the application to the production of vacuum for atmospheric railways that is the novelty, and of this Carson cannot be viewed as the inventor, either in the eye of the public or of the law.

Perhaps the patent sealed the 18th of Nov. last, in the name of one Henry Dircks, who is, I presume, your correspondent, may turn out to be a mere *rechauffe* of this very old mode of evaporating vegetable extracts, and that it was in the pains of parturition of this invention of his, that he stumbled upon this mare's nest of Mr. Carson's, about which he has so fussily busied himself with no result but to show the public how little he

* We shall do so in our next.—Ed. M. M.

has to do, and how incapable he is of deciphering the claims of a patent, or determining the rights of an inventor.

I am, Sir, your most obedient,

ROBERT MALLET.

Dublin, December 8th, 1845.

ROWING BY STEAM.

Sir,—I was much interested by your correspondent "H.'s" remarks concerning rowing and paddling. I perfectly agree with him in his opinions, and therefore conclude that, as oars are better than paddles, *machines* for rowing, must be superior to those for paddling. The accompanying figures illustrate an invention of mine for this purpose, which, without the slightest intention of detracting from the merits of "H.'s" invention, I offer to your notice.

Fig. 1.

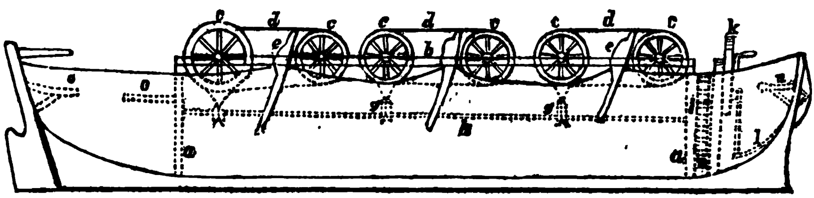


Fig 2.

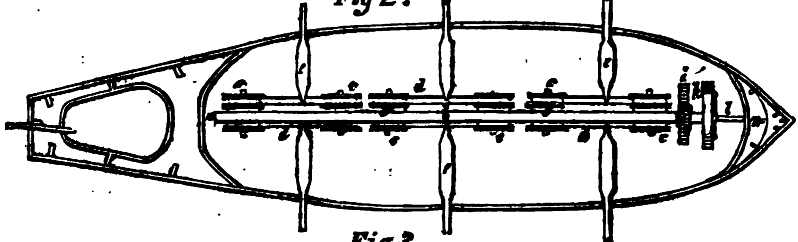


Fig 3.

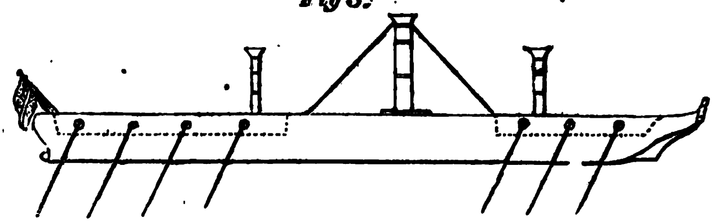


Fig. 1 is an elevation, and fig. 2 a plan of this apparatus, as applied to a small boat. *a a* are two uprights set up in the boat, and having a cross beam, *b*. On this are 12 wheels, *c*, fixed at proper intervals, one on each side, each pair being on the same axis. Over these wheels, belts, *d*, work, to which the oars *e* are attached; *f* are drum wheels, which impart motion to the said wheels from smaller ones, *g*, on the horizontal shaft, *h*, by means of straps. At the fore end of this shaft is a cog wheel, *i*, which engages with a pinion, *j*. On the axis of this is a fly wheel, *k*, to which motion is imparted by a pedal, *l*. *m* is an upright, to receive the spindles of the pinions and fly wheel. The pedal is worked by one or more persons, who sit on a bench, *n*; *o o* are benches for pilot and passengers. Below the horizontal shaft there would be stowage room for the goods.

Fig. 3 shows the same principle applied to a river steam-boat, in which case, I think, the invention would be used to the greatest advantage. In this case, a partition of 2 or 3 feet in depth must be made between the decks and cabins, and extending the whole length and breadth of the vessel, for the reception of the apparatus for working the oars. This partition is indicated by the

dotted line; in that part of the vessel occupied by the engine, it is discontinued. Chains must be substituted for belts, and toothed gearing for the straps which impart motion from the horizontal shaft; holes must likewise be made in the sides of the vessel, for the oars to work in.

Having thus described my invention, I will proceed to state the advantages to be derived from it, as applied in the latter instance. First, a much greater speed can be attained than with the paddle-wheel, with a less expenditure of power, as fully demonstrated by your correspondent "H."

Second, There is less, if any, disturbance in the water, than with the paddle wheel, *i i i*. As the motion of the oars is slow, the engines will not be required to work at the speed they do at present, and so be less liable to derangement or wear.

And, lastly, the ugly paddle-boxes would be removed, and a classical and picturesque bank of oars put in their room.

Now the only disadvantage of this apparatus, which appears to me, is, that the machinery for working the oars would occupy *too large* a space in the vessel; but as *passenger* boats are not required to have much stowage room, this would be very slight.

As to the application of this principle to *marine* boats, I fear the oars would be liable to breakage from the waves, and the apparatus for working them likely to be injured.

I am, &c.

Θεωνδωρου.

THE INVENTION OF THE PORTABLE CISTERN — REPLY TO "A FIREMAN'S" NOTES. BY MR. BADDELEY.

> "The inestimable estimate of Brown
> Rose like a paper kite and charm'd the town;
> But measures plann'd and executed well,
> Shifted the wind that raised it, and it fell."
>
> COWPER.

Sir,—In my brief narrative, comprising a twenty-five years' history of *my invention* of the *portable cistern*, (vol. xlii. page 275,) I observed, that "while the public had been largely reaping the benefits of this invention, the merits of the inventor have been dwindling down to a *first idea*—and that, only awarded upon compulsion."

At page 43 of your present volume, "A Fireman" volunteers a gratuitous confirmation of this statement, and also shows upon what shallow grounds and contemptible pretences, my merits are attempted to be shorn of their fair proportions.

As the rights of inventors generally, and of myself in particular, are strangely jeopardized by the novel and outrageous doctrines enunciated by "A Fireman," I must crave a small space to enlarge upon my "narrative" so far as is necessary to clear away the cobwebs which prejudice—that spider of the mind—has been so busily spinning round it.

To invalidate my claim to the invention of the *portable cistern*, it behoves "A Fireman" to deal honestly with its history; to begin with the beginning in the year 1820. The improved stopping board and *portable cistern* with *canvas bottom*, are asserted in my narrative to have been publicly shown, and used in that year; nor is this contradicted by "A Fireman," who carefully avoids this circumstance, and disingenuously takes up the history at the (to him) more convenient date of 1827. Had it been in the power of "A Fireman" to contradict, or throw the slightest discredit upon the early history of my invention, it is evident the will would not be wanting. In the absence of this refutation, however, his paltry attempt to divide the honours of the invention between Mr. Church and Mr. Browne, proves futile. Had the suggestions of both these gentlemen been perfectly original, inasmuch, as second inventors have no rights, the suggestions of 1834 must succumb to the claims of 1820.

In my narrative, I had charitably drawn a curtain over the transactions of 1834, merely observing, that "the utility of my invention was no sooner established than my claim to be the inventor was disputed." As "A Fireman" rakes up details, I must explain them. In 1834 I was told that the *portable cistern* was invented by "*a man* in Spitalfields;" but more of his local habitation or his name I could never learn, until it transpired during the present discussion. "A Fireman" now states, that a Mr. E. Church wrote to the Committee of the Fire Brigade, proposing a box 3 feet × 2 feet × 14 inches, but that *his* suggestion was *not* adopted, being set aside by a proposal made by Mr. W. M. Browne of the Westminster Office, whose plan was forthwith adopted

—Spitalfields Church being, in fact, done Browne! Upon the uprising of the "man in Spitalfields," whom I had all along supposed to be an imaginary person, I advanced my claims, and at this juncture Mr. Braidwood laid my several publications in the *Mechanics' Magazine*, as also my early manuscripts, before the Committee of Managers of the Fire Brigade, by some of whom they were recognised and identified; these documents clearly and indisputably established the priority of my claim to the entirety of the invention, and showed that the forms I had given to the *portable cistern*, left little room for either novelty or improvement.

In my report of London fires in 1835, (vol. xxiv. page 363,) it will be seen I stated, that "during the last year I had the gratification of seeing two contrivances of *mine* for obtaining a speedy and convenient supply of water to fire-engines extensively and successfully employed. These are *my portable dam*, and my improved stopping board. The nature of this gratification will be better understood, when I state that, for nearly 13 years, I have been labouring to overcome the opposition made by ignorance and prejudice to their introduction." I also stated that I had placed patterns of these, *my inventions*, with an engine manufacturer *pro bono publico*.

This report was accepted and circulated by the Committee of the Fire Brigade, (of which Mr. W. M. Browne was one,) without comment or contradiction; as was also my report for the following year (vol. xxvi. page 363) containing the following paragraph. "During the past year *my* long despised *portable cisterns* have been in constant and successful employment."

In my communication to the Society of Arts, (dated March, 1838,) I stated that "*these portable dams* have for the last four years been constantly employed by the engineers of the London fire establishment, with incalculable advantage. Their value at the late fire at Davies' wharf, Horsleydown, was strikingly manifest." In the testimonial to the Society of Arts, furnished me by Mr. Braidwood, my representations are fully confirmed, and to prevent any mistake as to the character or identity of the invention, he specially refers to those employed at "the fire at Davies' wharf."

In the face of all these, and many other similar facts that might be adduced, to the same effect, "A Fireman" has the audacity to advance a proposition which goes to charge Mr. Braidwood with the blackest ingratitude and injustice towards one of his employers, and with a wilful and deliberate fraud upon the Society of Arts! Is it at all likely that Mr. Braidwood would have thus acted? Could he with impunity have overlooked the invention of his employer, and robbed him of his fair fame, to save an individual who had no particular claim upon his good offices? Common sense, as well as common honesty, supplies a negative to the base insinuations of the anonymous calumniator!

The only valid reason then, which "A Fireman" has left him in support of his charge, that I have "overrated the value of *my share* in this affair" is, that the *portable cisterns* now in use are not exactly of the same *dimensions*, nor precisely of the same *pattern* as that which I first employed! If "A Fireman" is to be believed, however, he knows nothing at all about either the pattern or dimensions of my first canvas bottom portable cistern of 1820. I have already fully explained the reasons (p. 276) which led me to adopt another form and construction, and these were of a size suitable for the fire-engines to which I then had access—parish and private engines of small sizes—for which, notwithstanding "A Fireman's" equivocal denial, they were admirably adapted and frequently used.

That invention is limited to *pattern* or *dimensions*, I deny. Adopting such a mode of reasoning "A Fireman" might argue that Watt was not the inventor of the condensing steam-engine—Arkwright of the spinning jenny—or, Symington of steam navigation!

The very gist of my invention of the *portable cistern* (as fully set forth in your early volumes) was, to obviate the difficulty, danger, and delay arising from the practice then resorted to of breaking up the street paving to form a dam for supplying the fire engines with water. This eminently desirable object has been fully accomplished by my invention in all its places, and it is now almost universally employed for that purpose throughout the kingdom. The precise

form or dimensions, are by no means material elements of its success; had I been affluent enough, or my friends silly enough to have secured a patent* for my invention, the drawings and descriptions which I exhibited in 1820 would have sufficed to secure my rights, unimpaired by the slight modifications subsequently introduced.

Although a strong impression prevails among some of the firemen that the portable cistern is Mr. Braidwood's invention, and is so described to visitors, no claim is put forth by "A Fireman" in Mr. Braidwood's behalf, and I strongly suspect that Mr. Church and Mr. Browne will give "A Fireman" mighty little thanks for his indiscreet and officious interference as concerns themselves—for his impudent attempt to decorate them with the laurels he has stolen. It is a matter of satisfaction to know, that the forthcoming Parliamentary enquiry will put all these matters straight.

I had been informed by Mr. Braidwood that the Committee of managers of the London fire-establishment had expressed an intention of making me some *suitable acknowledgment* for the benefits they had derived from the use of *my inventions*. "A Fireman" contradicts Mr. Braidwood, and says, "it was not on account of my inventions, but for my services as an amateur fireman, and as a writer who had lauded the brigade," &c. If there was any truth in this statement, however, how was it that Mr. Braidwood based his application on the letter containing the award of the Society of Arts? Or why, upon his want of success in the first instance, did he request the loan of *that letter* at a later period? As to a *pecuniary* recompense, it was altogether out of the question, and for this simple and sufficient reason, viz., that the Committee could not be expected to award me a tithe of the sum I had expended in maturing and introducing my inventions.

Few persons know better than "A Fireman," how readily my *services* and my *writings* would have been dispensed with: my vigilance in the one case, and my independence in the other, were never palatable, and very intelligible hints to that effect have frequently been given me.

At present I can say that the most wealthy and influential body in this metropolis are—and so I am pleased they should continue—my debtors; the independence of my spirit, and the integrity of my character render me proof alike against temptation and intimidation—the one I despise, the other I defy. Strong in these principles I hope I shall continue to yield—and therefore am entitled to exact "Honour to whom honour is due."

I remain, Sir,
Yours, very respectfully,
WM. BADDELEY.

29, Alfred-street, Islington,
Dec. 3rd, 1845.

* Such a patent would have expired before the invention came into use; as did Deane's patent for his *now* highly prized smoke-proof dress.

NOTE FROM "A FIREMAN."

"A Fireman" begs the Editor of the *Mechanics' Magazine* will intimate to his readers, in any way which he may deem best, that he is only waiting the conclusion of Mr. Baddeley's series of replications to his "Notes," to dispose in a few pages of the entire series, and therewith to bid adieu to the subject. He trusts, in the mean while, that verbal abuse will not be mistaken for argument, nor the bombast of stilted arrogance for the voice of injured merit. Mr. Baddeley writes as if he were a very ill-used gentleman—assailed without provocation, and criticised without mercy; whereas in truth Mr. Baddeley has been himself the assailing party—the volunteer traducer of an important public department, and most useful public officer, (once praised by none so highly as by Mr. Baddeley himself,) and all that "A Fireman" has done, has been to say a word or two in defence and vindication of the objects of Mr. Baddeley's most unmerited calumnies.

London, Dec. 8th, 1845.

THE ROYAL SOCIETY AND MR. BAIN'S ELECTRO-MAGNETIC DISCOVERIES.

Sir,—The strictures upon the conduct of the Royal Society contained in your notice of Mr. Tait's work (in No. 1152) induces me to send you the following particulars, in confirmation of the opinion you have there given.

In October, 1842, Mr. Alexander Bain discovered, by a long series of experiments, followed up by close and just reasoning, that two dissimilar metals, when placed in moist earth, whether,

near, &c., or at a great distance from each other, produced a very uniform and constant electric current. When this fact was communicated to one or two members of the Royal Society, the information was received with great scepticism, but eventually, when convinced, one of these gentlemen promised a friend of Mr. Bain's that if a paper were given him explanatory of the subject, he would read it at the next meeting of the Royal Society; but when the paper was sent to him, it was returned with the following note,*—

"*June 1st*, 1845.

"Dear Sir,—I am sorry I must decline presenting the paper of your friend.

"I am, dear Sir,

"Yours faithfully,

"* * * *"

The editor of a scientific journal attempted to justify this decision, because "Mr. Bain had taken out a patent before the paper was sent to the distinguished member of the Royal Society." He says, "Is it to be wondered at that he declined presenting it? It had then ceased to be a scientific communication,—the discovery had been made a matter of merchandise." This is the only attempt that I have seen at a justification of this refusal. Now, Mr Editor, let us see how other cases will bear this test. Please to remember that Mr. Bain's patent received the great seal just three days previous to the date of the above note,† consequently no publication had taken place, and that the patent was not for the discovery itself, but for its *application to two mechanical instruments*, (his clocks, and telegraphs.) We will select two cases, one before and one after the above transaction, to show that no alteration of circumstances can account for the difference of treatment.

It appears from Mr. Charles Wheatstone's statement, that on the 26th of November, 1840, a paper of his was read before the Royal Society, fully describing his electro-magnetic telegraph clock, and an abstract of his paper was published in the Society's Proceedings; and in the same letter this gentleman states that this instrument was *secured to him by patent in the previous January*,‡ therefore his specification *must* have been lodged, and consequently his invention published *three months previous to his paper being read on the 26th of November.*

On the 15th of June, 1843, it appears "The Bakerian Lecture" was "an account of several new instruments and processes for determining the constants of a voltaic circuit, by Charles Wheatstone, F.R.S., &c."§ Amongst other matters this paper gives the definition of several new terms sanctioned by Ampere. "*Rheo-stat is applied to the instruments which form the chief subject of this paper.*" The words underlined are not mine, but quoted from the *Electrical Magazine*. It is quite unnecessary for me to copy the description of the *Rheo-stat* described in the above journal, (the author of which has abstracted it from the *Phil. Trans.*) as you, or any of your readers, if they will visit the enrolment office, Chancery-lane, will *there find a full and exact description of these instruments in a specification of a patent*, deposited by Charles Wheatsone, Esq., on the 7th of January, 1842. I think I saw in your Magazine, that Mr. Wheatsone has been presented with the Society's gold medal for this very paper, although I cannot just now lay my hands upon the Number.

Allow me to bring your attention to the fact, that the first paper *received* contained no *new discovery*, but the mere mechanical application, of the long before well-known properties of the *electro magnet* to a particular instrument; and the second paper *received* and honoured by insertion in the *Phil. Trans.*, likewise contained no new scientific *discovery*, but just, in plain English, a method of measuring the force of electric currents, and both had been published months previous to their presentation to the Royal Society—the last mentioned, *eighteen* months; whereas Mr. Bain's paper, *rejected*, did contain a scientific discovery never before dreamed of, with no mechanical application of it, and it had not been published, and therefore we might have supposed it a communication just suited for these learned *savans*. How can the different treatment of these two gentlemen be accounted for? Surely not because one had F.R.S. tacked to his name, and the other not.

* Electrical Mag. vol. I., No. 2, p. 141. † Ibid.
‡ Literary Gazette, June 18, 1842.

§ Electrical Mag., vol. I., No. 3. p. 201-3.

I have only to add that I have no motive for pointing out these three cases in particular, except that they will admit of no dispute, as I have stated nothing but what can be seen by any one who will take the trouble to look into the different publications I have referred to, and quoted from. I should have sent these few remarks sometime sooner, but had not an opportunity of looking at the specification until yesterday.

I am, Sir,
Your old subscriber,
T. W.

December 10th, 1845.

P.S.—Upon second thoughts, I here send you the description of the *Rheostat* as given in the BAKERIAN LECTURE, and below it is the claim made for the instrument, in the *specification*.

From the Bakerian Lecture.

"The RHEO-STAT, for considerable resistances, consists of two parallel cylinders, one brass, the other wood, with a spiral groove: a wire of small diameter, and of sufficient known length to fill the groove, is wound round the wooden cylinder, one of its ends being in contact with a spring, for connection with the *rheo-motor*. The other ends being fixed to the brass cylinder, a spring connecting the latter with the other termination of the *rheo-motor*. Under these circumstances, the *whole* length of wire is included in the circuit; but as more or less of it is wound on the brass cylinder, so does the effective part of the length vary."*

From the Specification.

"I claim the method above described for varying or regulating the resistance in an electric circuit by occasioning the current to pass through insulated wire† suitably coiled or bent, the length of which interposed in the circuit is capable of being varied."‡

You know *something* of patents, and specifications, Mr. Editor; now tell me, supposing these two extracts being both taken from the latter instrument, could the description and claim be better given? T. W.

* Electrical Mag., vol. i. No. 3, p. 203.
† Insulated by being coiled in a spiral groove on a non-conducting material, *not covered wire*.
‡ Mr. Charles Wheatstone's specification, lodged at the Enrolment office, January 7th, 1842.

THE MAGNETIC TELEGRAPH IN AMERICA.

The establishment of magnetic telegraphs, radiating from New York to the east, west, and south, to the extent of three or four hundred miles, so as to connect all the large cities of the Atlantic border with this metropolis, is now in a rapid state of progress. The line between this and Buffalo is under weigh, and so also is the one to Boston, so likewise that between this city and Washington, including all the intermediate points. There is also a line commenced between the city and Coney Island. All these lines are conducted by associations of individuals who derive their powers from the inventor, Professor Morse, now in Europe. It is supposed that the whole of them will be finished in the course of three or four months; and that the principal line between this city and Washington will be completed in time to transmit the next message of the President to this city, and to enable the publishers to issue it simultaneously with the Washington papers. When completed, these united lines of telegraphic communication will embrace a territory of nearly 500 miles from south to north, and from east to west—including within its ramifications the metropolis, Washington, Buffalo, Boston, with all the intermediate cities, as part of the grand scheme of communication. Such a system of telegraphic communication of all descriptions of news, will make the great Atlantic cities suburbs of this metropolis, and all animated by the same spirit and the same impulses, numbering, probably, a population of nearly 2,000,000 of the most active, talented, intellectual, impulsive, and most energetic business men on the face of the earth. It will not be forgotten that this vast and comprehensive scheme of telegraphic communication will be completed in the course of a few months, and be in the hands of individuals for their own advantage and purposes, without any responsibility to Government or society in any particular whatever. One of the lines of telegraph, and the shortest and most unproductive, that between this city and Coney Island, has already made propositions to the newspapers, offering to give them intelligence of ship news and other marine matters at the rate of 50 dollars per week—a sum nearly double that which is now paid under the old method. This is a sample of what may be expected from the other companies and associations, provided they should be allowed to establish their vast and comprehensive schemes without being liable and responsible to any of the legislative powers of the country. In fact, we believe that the magnetic telegraph is going to produce a

greater change in some of the social institutions of the country than any one now imagines.—*New York Herald.*

THE PADDLE-WHEEL *v.* SCREW; TRIAL OF SPEED BETWEEN THE "FAIRY" AND "WONDER," IN PRESENCE OF HER MAJESTY'S MINISTERS.

A long-sought-for trial of speed between H.M. steam tender, *Fairy* and the *Wonder*, Southampton and Jersey packet; the former fitted with oscillating engines and screw, by Messrs. Penn and Co., and the latter with atmospheric engine and paddle-wheels, by Messrs. Seaward and Capel, came off on Wednesday last, on the occasion of the *Fairy* taking her Majesty's ministers to and from the Isle of Wight. The *Wonder* went down to Cowes on purpose to meet the *Fairy* on her return. The two vessels made a fair start from the Brambles, (off Cowes,) and after a rapid run to the Southampton Docks, the *Wonder* beat her competitor by four minutes in time, or about one mile and a half in distance, showing a superior speed equal to nearly three miles per hour.

ABSTRACTS OF SPECIFICATIONS OF ENGLISH PATENTS RECENTLY ENROLLED.

PRYCE BUCKLEY WILLIAMES, OF LLEGODIG, MONTGOMERYSHIRE, GENTLEMAN, *for certain improvements in the manufacture of artificial stone.* Patent sealed, March 17, 1845. Specification enrolled, September 17, 1845.

Mr. Williames employs for the base of his artificial stone, sulphate of barytes, reduced to an impalpable powder, and mixed with some flux, such as fluorspar, quartz, borax, &c. For the production of a fair specimen of white marble, we are directed to take of sulphate of barytes four parts, by weight, crown glass, one part, and dried borax about one-fourth of the weight of the crown-glass; these are to be finely pulverised and intimately mixed; then, placed in a covered vessel, trough, or pot, according to the size and shape required, placed in a furnace, and subjected to an intense heat. It is stated to be necessary to heat the pots before putting in the ingredients, and that every precaution should be taken to exclude all carbonaceous matters, which would convert the mass into a hard refractory body, totally unworkable and useless; for this reason, the pots should not be put into the fire until it is clear, and there is no unconsumed carbon floating about, or they should be carefully covered up, and the heat be allowed to play around them freely. When the composition is completely agglutinated, or melted, which is ascertained with a trial-rod, it is poured into moulds to form blocks or slabs, as may be required, and allowed to cool very gradually in a part of the furnace from which the intensity of the heat is cut off. The pots, or melting vessels, must be made of the best fire-clay, and all carbonaceous matters carefully excluded from their composition. When it is required to produce grained, or veined marble, the patentee employs those metallic oxides which are not volatile, and which are used for the same purposes by porcelain manufacturers. His "claim is to the production of a composition from sulphate of barytes, mixed with other materials or ingredients, such as glass, borax, and other fluxes, for the purpose of more easily fusing or agglutinating the same into a solid mass."

CONSTANT CHAMPION, OF LONDON, MERCHANT, *for improvements in burning animal charcoal.* (Being a communication from abroad.) Patent dated March 17, 1845; Specification enrolled September 17, 1845.

These improvements "in burning animal charcoal" would have been more properly described as improvements in depurating or revivifying animal charcoal after it has been employed for clarifying syrups, and has lost through use its purifying properties. The used charcoal is first washed; then placed on a drying floor heated by under flues, from which, after it is well dried, it is transferred to a series of pipes or tubes of fine clay, placed on end in a chamber or oven, where it is subjected to a strong heat, from twelve to fifteen minutes; from these pipes, it is allowed to drop in a red-hot state into the open air, where it is left to cool, (without the application of water,) but stirred the while, in order to prevent it from whitening.

HYPOLLITE CHAUVIER, OF LONDON, *for improvements in the manufacture of soap.* Patent dated April 9; Specification enrolled October 17, 1845.

M. Chauvier's *improvements* (?) in the manufacture of soap, consist,—1, in making it from the hair or fur of seals, or other marine animals, instead of the oil or fat of the animals, as heretofore; and, 2, in making it half of hair and fur, and half of "common salt"! "In order to make hard soap, I change the basis of the alkali employed by throwing *common* salt into the copper, *about the half in weight of the quantity of hair employed.*"

CHARLES LOUIS MATTHURIN FOUQUET, OF JERMYN-STREET, *for improvements in the preparation of artificial vegetable gum to be used as a substitute for gum Senegal.* Patent sealed April 22, 1845; Specification enrolled October 22, 1845.

Mr. Fouquet's substitute for gum Senegal is a composition formed of the fecula of the

potato 100 lbs., starch 20 lbs., sago 20 lbs., and malt 20 lbs. These materials are first well mixed up together in water, and heated "until the matters are brought into a gummy state;" the mixture is then raised by steam to "a temperature of 100 to 105 degrees of Centigrade's thermometer (*sic* in orig. !) when the steam is shut off and the materials allowed to remain for about an hour; then they are to be filtered, by passing them through waste cloth or any other suitable material;" after which, the gum is concentrated by evaporation.

Charles Robert Roper, of Hackney, Chemist, *for improvements in the manufacture of gelatine.* Patent dated April 22, 1845; Specification enrolled October 22, 1845.

If you wish to make a lemon-flavoured jelly from gelatine, you may mix with it an equal weight of lemon-flavoured sugar; if an almond-flavoured blancmange, an equal weight of almond-flavoured sugar; and so also, other essences or essential oils suitable for flavouring may be used with sugar and gelatine. But nothing of all this you must do without leave and licence obtained of Mr. Charles Robert Roper, of Hackney, aforesaid!

Samuel Wilkes, of Wolverhampton, *for improvements in the manufacture of hinges.* Patent dated April 26, 1845; Specification enrolled October 26, 1845.

Mr. Wilkes first forms, by casting or otherwise, the knuckle joints of the hinges without any flaps attached to them; these joints are then slipped upon a common axis; and being deposited in a suitably formed mould, the flaps are finally added by running in. It is stated not to be necessary that the knuckle joints should be of the same metal as the flaps; for example, the joints may be of brass and the flaps of cast-iron, or of cast-iron covered with thin sheet brass.

Frederick Ransome, of Ipswich, *for improvements in combining small coal and other matters, and in preserving wood.* Patent dated May 10, 1845; Specification enrolled November 10, 1845.

Mr. Ransome uses for the purpose of combining small coal and other matters, a cement made from silica in the following manner:—

"I dissolve one hundred pounds of crystallized carbonate of soda, usually called sub-carbonate of soda, or in commerce frequently termed merely soda, in so much water as shall make the solution of the specific gravity of about 1·150 at the temperature of sixty degrees. I then render the carbonate of soda caustic, in the usual and well-known manner, by means of lime; or instead of carbonate of soda, I employ about fifty pounds of carbonate of potash, usually called pearlash, and the requisite quantity of water and render it caustic by means of lime. I then put this caustic alkaline solution with about one hundred pounds of finely-broken flints, or other convenient siliceous substance, into an iron boiler or digester, and heat the mixture during ten or twelve hours, up to a temperature of about 300 degrees Fahrenheit, frequently stirring the mixture. When the mixture is sufficiently incorporated, which will readily be ascertained by a workman after a little experience; it may be removed from the boiler or digester, and passed through a suitable sieve, by which any undissolved stone may be removed from the paste or cement. I then evaporate the solution till the specific gravity is increased to about 1·500, at the temperature of sixty degrees. The cement is then fit for use, or may be tempered to any required consistency, either by evaporation, or by the admixture of sand or finely-powdered flint. I generally use for the purpose, calcined flint, and if it is too thick, the same may be reduced by adding water."

In applying this cement to the making of artificial coal, Mr. Ransome proceeds as follows:—

"I usually take about one hundred parts of coal dust or small coal, and mix it intimately with from one-tenth to one-twentieth of its weight of the siliceous cement, prepared as before described; but it is obvious that the quantity of cement required will vary according to the size of the particles of coal used in the mixture, the design being in all cases to economize as much as possible the use of the cement, and yet to produce the fuel of the required stability when dried. The mixture thus prepared is put into suitable moulds, to form lumps or blocks, subjected to hydraulic or other mechanical pressure; after which it is taken from the moulds, and allowed to dry at the common atmospheric temperature for a few hours, when it may be removed, and placed in an oven or hot room. I also find it advisable, for the purpose of effecting the more perfect combustion of artificial fuels generally, as well as my own above described, to form one or more holes through each lump or block of fuel, for the free admission of air during the process of combustion, and this is easily accomplished, by inserting in the moulds one or more plugs or cores, slightly tapered, which can readily be withdrawn after the fuel is compressed."

In the case of wood, the siliceous cement is forced into, and incorporated with it, by atmospheric or hydraulic pressure; and then rendered insoluble by steeping the wood in some acidulated or saline solution.

A MATHEMATICAL PRODIGY.

The following article, taken from the Western Episcopalian, published at Gambier. Ohio, is from the pen of the Rev. George Dennison, formerly Professor of Mathematics in Kenyon College.

Mr. Editor—Perhaps you have seen in the political papers of the day mention made of a child in this vicinity of most astonishing intellectual ability. Being on a visit to my father, I yesterday went to see this child, and verily believe him to surpass anything of the kind on record in the history of man, and to open a door by which we are permitted for a time to see something of what our minds are, and what they become when this natural body shall have been exchanged for the spiritual.

This child's name is T. H. Safford, jun.; he is now nine years and six months of age, of small stature, and pallid countenance; his little arms are not much larger than my two fingers! he is of noble carriage, frank yet not forward. His eye is his most remarkable feature, being very large and bright, and when excited it rolls in its socket with an almost spasmodic force, while his little hand is thrown over them both in such a way as to indicate pain. I am told that there is scarcely anything in the circle of sciences with which this child is not acquainted. History, and particularly natural history, is his favourite. I examined him, however, in nothing but mathematics and astronomy. His father and myself were old Sunday-school scholars together, and every opportunity was given me to test the child thoroughly.

I will now proceed to give some account of a long examination. While the child was not yet come in from the field, where, with his little sister, he was gone to gather wild berries, I examined an almanac in manuscript for A.D. 1846, all of which this child has wrought out *alone;* much of it, including one of the eclipses, before witnesses with whom I am acquainted. About 12 days have already been spent by an adult in copying in a fair hand the most illegible writing of his tiny fingers. We were examining the projection of the eclipses, which he himself had made and subsequently calculated, when he came in. I told him of the blind student in Kenyon College, who was studying the Differential and Integral Calculus. He seemed much pleased, and said he did not think he could have done that without sight. I asked him of the projection which lay before us; he immediately commenced a full explanation, and I felt as his little hand ran rapidly over the diagram, and I listened to his childlike expression as if I were in the presence of some superior being. In some instances I puzzled him, but never did he appear fretful; and when I told him anything he did not know, he always repaid me with a smile.

I asked him if two circles cut each other to the extent of 1-2 their diameter, what area would be thus cut away? Quicker than I could think, "The 144th part." I then asked him if 3-12, or digits, were thus cut, and he instantly said, "1-16." I asked him how he knew, and he said, "3.12=1-4 squared is 1-16." I asked him why he squared it? He said, "It is so in a semicircle, and must be so in a circle." I then told him the rule of homologous sides, and he smiled and said he understood it. I then asked him if two legs of a right angled triangle were given, one 12 and the other 16, what the hypothenuse would be? and he instantly replied, "20; wouldn't it? Yes!" I then said, "Suppose the legs were 8 and 15; then what?" In half-a-minute, and without a pencil, he replied, "17.885." I then asked him, "If the legs were 7 and 15, then what?" He was rather longer in answering, but took no pencil, and replied, "61.553."

I gave him the following questions: The square of 465? He said, 216,225. The cube of 26? He answered 17,576. I asked him if I might try him on the fourth power? He said yes, if I would not go beyond two figures. I asked him the fourth power of 75. His eye whirled and he sprang like an arrow to the door hung by one hand to the door post, and came, in say three-fourths of a minute, and replied, thirty-one millions, six hundred and forty thousand, six hundred and twenty-five, (31,640,625.)

As he had performed all these in his head, I was desirous of knowing what his process was. I therefore gave him a sum of four figures, on the slate. He took the first figure and run it through as we do from right to left, and then wrote the second line back again from left to right, and so on. He did not multiply one figure of the multiplicand by itself, but always two.—His calculations entirely outstrip the capability of his pencil to record them.

I tried to make his parents feel that he was a treasure lent. The mother evidently felt it so, but the father seemed unwilling to hold the fond belief that he might become so wonderful man as he surely is a child. At all events, I cannot but feel as if I have seen something of what we yet may be when mortality shall have been swallowed up of life.

GEORGE DENNISON.

Royaltown, Vt., Aug. 2, 1845.

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

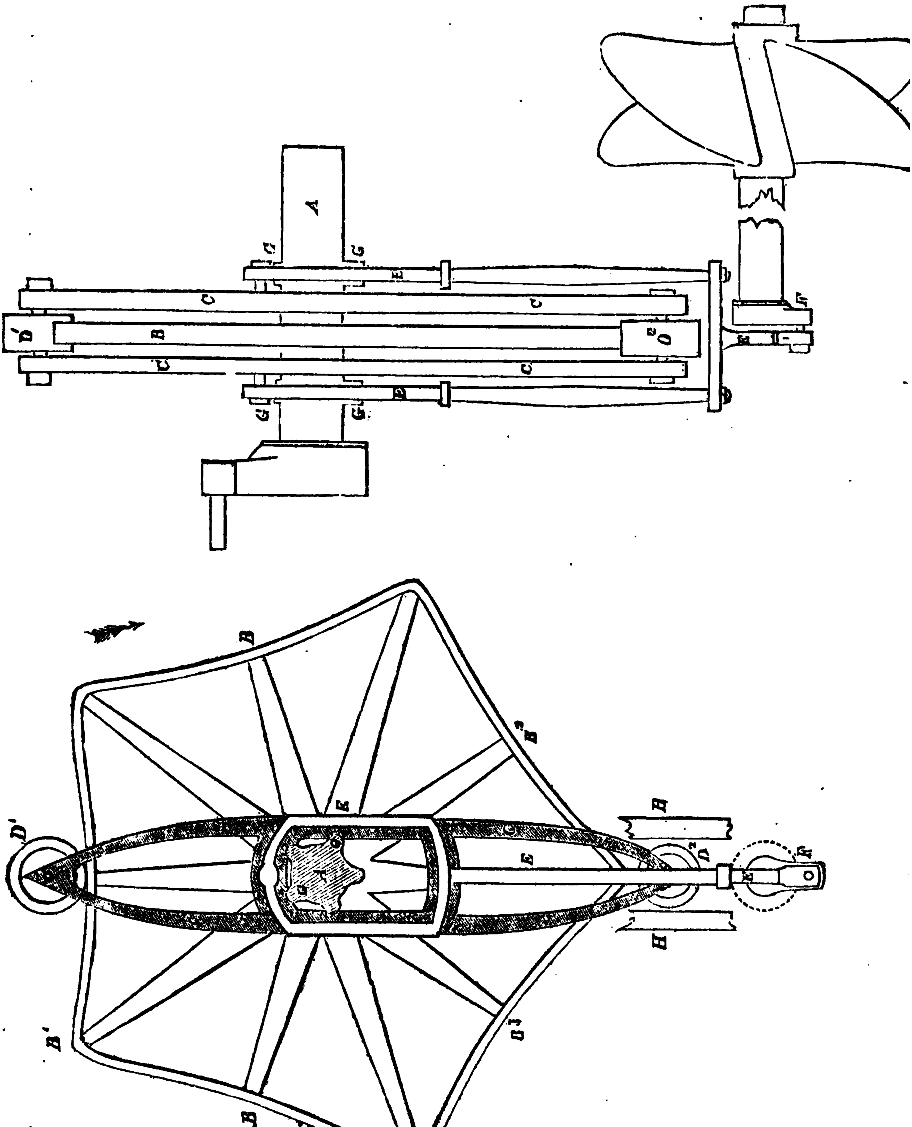
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1167.] SATURDAY, DECEMBER 20, 1845. [Price 3*d.*

Edited by J. C. Robertson, No. 166, Fleet-street.

ENGINE SHAFT AND SCREW SHAFT CONNECTING APPARATUS.



PLAN FOR COMMUNICATING MOTION FROM THE ENGINE-SHAFT TO THE PROPELLER-SHAFT IN SCREW-PROPELLED VESSELS.

SIR,—I beg to forward to you a plan for communicating motion from the engine-shaft to the screw-shaft in steam vessels, which I should be glad to see inserted in your Magazine.

I am, Sir, your obedient servant,

J. V.

July 26, 1845.

Description.

On the engine-shaft A, is fixed the driving-wheel B, having an undulating rim, as seen in fig. 1; C is a frame with a wheel or roller D at each end, which wheels, or rollers, are acted upon by the wheel B. E is a connecting-rod, which proceeds from the frame C to the crank F on the screw-shaft; G G are cams placed on the engine-shaft to prevent the crank F stopping on the centre; H H are guides to keep the frame C in a vertical position.

The action of the machinery is as follows: Motion being given to the wheel B, in the direction of the arrow, causes the wheel D, and frame C, to rise until the point B^1 arrives at its highest, while, at the same time, that part of the wheel marked B^2, will arrive at its lowest. Then, on the arrival of B^2, at the place marked B^3; the wheel D^2, and frame C, will descend to the position in which it is represented in the engraving.

Now, there are five projections in the wheel B, with five cavities, so that one revolution of the wheel B, will cause five double strokes of the frame C, and the connecting-rod E, will communicate the desired motion to the screw-shaft.

STRICTURES ON COMMANDER HOSEASON'S LETTERS TO SIR W. PARKER AND SIR G. HAMMOND, ON "WORKING STEAM EXPANSIVELY IN THE ROYAL NAVY." BY "PRESSURE NOT PUFF."

"The power that I have on you, is to spare you. The malice towards you, to forgive you. Live, *and deal with others better.*"—CYMBELINE.

Having answered the remarks made by Mr. Hoseason, in No. 1162, I shall endeavour to avoid touching again on the same points as much as is possible, consistently with a full exposition of the errors which abound in his letters.

It will be well to keep in mind, that those letters contain *but one truth*, that of the theory of the expansion of steam; which, as most of your readers know, was discovered by Watt, included in his *third* patent, enrolled July, 1782, and fully detailed by Farey, p. 347, and most other writers on the steam-engine. My attention, therefore, will be alone directed to what is, or may be called, the data, facts, and reasoning, by which Mr. Hoseason has clouded this sublime specimen of the inductive reasoning of that great man.*

Passing over, then, in few words the important discovery that the square of 9 is *nearly* double that of 7, we come to this very reasonable proposition, that, "whenever a steam-ship is despatched, the admiral shall inform her commander what speed will answer all the purposes of the service;" in fact that *time* shall be considered. Although this may answer the peculiar exigencies of the royal marine, it is not applicable to commercial affairs, as I shall show when referring hereafter to the voyage of the *Great Liverpool*, from Malta. Be this, however, as it may, the merit of the suggestion belongs not to Mr. Hoseason, but to Professor Barlow, *who, four years and a half* before, suggested the same thing in a letter addressed to the Secretary of the Admiralty, nay, in almos. the same words, as "the results of experiments made on H. M. ship *Lightning*," (see Part I., App. p. 64, Weale's Tredgold.)

The *Stromboli* and *Medea* (p. 263)

* Allow me to beg that your readers will take an early opportunity to examine *a perfect copy* of all Mr. Watt's patents, (excepting that for the letter-copying machine,) which, with fac-similes of the drawings and illustrations, was last session presented to the Institution of Civil Engineers, by Mr. Carpmael. It was a noble present, and will well repay the trouble of perusal. I annex a brief abstract of its contents, where, among other things in the patent, containing what Mr. Steel calls "the almost divine parallel motion," (1163, p. 343,) they will find the oscillating engine, a *model* of which i now in existence, and under the fifth head, som thing like a modern invention of great utility.

are instanced as occasions on which coals might have been saved by the employment of half the power, *time* being of no object. A note to the same page furnishes another striking instance of the ungenerous way in which the author treats his brother officers of the *Stromboli*. He first accuses them of not husbanding their coals, and then acknowledges he does not thus accuse them from "unquestionable fact," but that if his accusation is *false*, it "may be an exception to prove *his* rule."—Conduct and reasoning such as this need no comment.

The note to which I have just adverted, brings me to one section of my assumed task, namely, to inquire whether Mr. Hoseason has, or has not, *any knowledge* of the quantity of power required for given velocities. His backing and filling upon this tack is very amusing; he has not, like Lardner, (see p. 284) lost his "third term in the proposition," because he has not yet possessed one with any degree of certainty. At one time we find him supporting the law of the *squares:* and at another, saying, (No. 1162, p. 330,) "I agree with your correspondent, that the required horse-power is as the *cubes* of the velocities"—a contradiction so remarkable, that it can only be accounted for by one supposition—that experience and reading may have taught him something, during the lapse of four years, since he first essayed authorship.

But my object is, not only to prove Mr. Hoseason's errors, but to supply an antidote to the poison already administered; for this Magazine is no stranger in the berths of our men of war. Therefore, the aforesaid note should be read thus. "A double velocity requires *eight* times the power. For example, the *cube* of 5=125, but that of 10=1000; he then, who would diminish the velocity by one half, must shut off seven-eighths of the steam."

It is also an amusing circumstance, that in the case of the *Hydra*, (p. 264,) Mr. Hoseason, like Lieutenant Knox of the *Phœnix*, proves the case *against himself*. He says, that she steamed from Suda to Malta, *full* power, at the rate of ten knots in *fifty-two hours;* when by *his* plan of *half* power, she would have done the same in *sixty-five* hours.

Now, this is in the *exact* ratio of the *cubes* of the velocities! And it should be remembered, that all this time he is advocating the law of the *squares* of the velocities! There is an error in the stated consumption of coals at 32½ tons, which should be 26 tons, half 52 tons,—*half* the power being used, (see Mr. Hoseason's own reasoning on this subject in the *Great Liverpool's* case, p. 282.) All that he has written, relating to the *friction* of the *Hydra's* engines, at the reduced velocity, is also incorrect, and can be clearly proved so by the testimony of the best authors.

Captain Murray's axiom that "the greater the velocity, the greater the saving of fuel," is perfectly true in certain cases, *i.e.*, where the same *power* is exerted, and his determination to "steam full power till he got into the trades, and then sail," might be all very proper and advantageous to the service, for anything Mr. Hoseason shows to the contrary. I do hope that one or more of these gentlemen will come forward and prove in your pages, that they are libelled men.

We now come to the travesty upon Dr. Lardner's work, (No. 1158, p. 264.) I can assure Mr. Hoseason, that if the "cone stood upon its base;" it is he who has invented it, and the poetical quotation applies with singular force to himself.

The Doctor is said to state, "that the result of experience, obtained in the steam navigation of our channels, and particularly in the case of the post-office packets, on the Liverpool station, has clearly established the fact that, by increasing the ratio of power to tonnage, an actual saving of fuel in a given distance is effected, while at the same time the speed of the vessel is increased."

This is all very true, and was indisputably proved in the experiments alluded to—those made on board H. M. packets, *Thetis* and *Dolphin*. These vessels were built in 1826, by Graham, of Harwich, and were each fitted with engines of 140-horse power, manufactured by Boulton and Watt. Their velocity at the measured mile in Long Reach was 10·35 miles per hour. It was subsequently found that a greater speed would be beneficial to the public service, and the power in each vessel was increased to 160 horses, which produced a velocity of 10·84 miles per hour, ascertained as before.

Now, this extension of power was effected by the *enlargement of the cylinders* (the boiler power being fully adequate); consequently, as no additional weight was put on board the vessels, their *immersions* and, therefore, their *resistances* were the same; the consumption of fuel, for obvious reasons, does not in this and similar cases increase in the same ratio as the powers. The result was, that, *less* coals were burnt in a given distance, and the Doctor's position fully proved. He appears to account for this result in a very different way; but as I cannot find the quoted passage in his last edition, (1840,) I presume that he found his speculations on *that* head to be incorrect.

We have seen that the additional twenty horses power raised their velocities just half a mile per hour, and how beautifully it proves the truth of the law of the *cubes!*

$$\left.\begin{array}{l}143^3 = 5{\cdot}192\\ 160 = 5{\cdot}428\end{array}\right\}\text{as } 5{\cdot}192 : 10{\cdot}35 :: 5{\cdot}428 = 10{\cdot}8204 \text{ miles.}$$

The substitution of 100 for 120 horses power on board the *Columbia*, as quoted by Otway, is a very different matter, between which and the *Dolphin* and *Thetis*, there is not the *slightest* analogy. Her 60-horses engines were too heavy; in fact, she was *overpowered*—her draught of water with the two 50-horses engines, fuel, &c., was nearly a foot less than with the sixties. Her resistance decreased in a greater ratio than the power, consequently her velocity was improved. Therefore, Mr. Hoseason cannot "plead an arrest of judgment," for here we have *one* effect arising from *two* causes; we have *increased velocity* produced in the one case by *increased power*, and in the other, from a *decrease of power*—"causes diametrically opposed to each other," and yet perfectly reconcilable with truth, and of easy elucidation, did time and space permit.

This, then, illustrates one sample of the crudities by which Mr. Hoseason so amusingly conceives that his "points are proved." But what follows (in p. 265) is still worse; it contains a statement which is not, and cannot be true.

You, Sir, well know, that the consumption of fuel in any given steam-engine, is *as the work done;* in other words, it will always be as the power exerted, (except in such a case as that of the *Thetis* and *Dolphin.*) Now, taking the *Medea* and *Great Liverpool*, whose powers are respectively 220 and 460 horses,* and supposing the same pressure per square inch on the piston (or indicator power) in both vessels, the consumption of fuel should be in the direct ratio of these powers; but, on the contrary, if these pressures differ, so would the quantity of fuel consumed. If we take the *Medea's* consumption at *one* ton per hour, (which is incorrect,) we have $\frac{2240}{220} = 10{\cdot}05$ lbs. per nominal horse per hour, and by the same authority assume the *Great Liverpool* to burn $\frac{1}{7}$th more, we have $2240 + 320 = \frac{2560}{460} = 5{\cdot}55$ lbs. per horse, per hour! I shall be content to leave this statement in the hands of the profession.

The consumption of the *Medea* is above truth, though not so much so as that of the *Great Liverpool* is below it, and it is not possible that difference of pressure in the two vessels can account for so extreme a variation.

Our "new light" lumps together "most of the large class steamers in the Mediterranean, though differing *materially* in tonnage, power, and velocity," as consuming "*on an average* a ton of coals *per hour!*" How worthy of all admiration is this scientific accuracy! The fact is, that these statements have been made from *hearsay* alone, without the slightest authority, and their absurdity is so great, as to destroy our faith in any matter of the kind brought forward by Mr. Hoseason.

I pass over one or two paragraphs, not because they are free from error, but because I have an eye to your valuable space.

In p. 282, (No. 1159,) we have the following:—"The *Great Liverpool* broke one of her pistons, and steamed 3,000 miles, at an average velocity of $7\frac{1}{4}$ knots (per hour) *which is as high an average as could possibly be expected*

* *Medea's* engines were made by Maudslay and Co. Cylinders, 55in. diameter; stroke, 5ft.; velocity of piston, 215ft.=110 horses each.

Great Liverpool's engines were made by Forrester and Co. Cylinders, 75in. diameter; stroke, 7·0 ft.; velocity of piston, 245ft.=230 horses each.

from her maximum velocity," *i.e.*, I presume, if the piston had been perfect, and *both* engines at work!*

Now, Mr. Editor, not only is this very palpable nonsense, but it is against the whole reasoning of Mr. Hoseason, especially in reference to the *Phœnix*. As he *now* admits the truth of the law of the *cubes*, it of course follows, that if the *Great Liverpool* steamed at the rate of $7\frac{1}{4}$ knots per hour with *one* engine, she must with *both*, and double the consumption of fuel, have been propelled above 9 knots, all circumstances being the same. Referring to a former part of these strictures, wherein I have mentioned the recommendation of Mr. Hoseason, (but in which he had been anticipated by Professor Barlow,) that H. M. vessels should use half their power when *time* was no object; let us see how this will look when brought to the test of figures, and applied to the *commercial marine*—that matter-of-fact service which reduces everything to the question of pounds, shillings, and pence.

Miles 3,000, are equal to 2,608 knots; and if the *Great Liverpool* steamed $7\frac{1}{4}$ knots with *one* engine we have $\frac{2608}{7\cdot25} = 360$ hours, or 15 days. On the contrary, if she had *both* engines at work, with a velocity of $9\frac{1}{4}$ knots, we should have $\frac{2608}{9\cdot25} = 271$ hours, or 11 days for the length of the voyage,—*a difference of* $3\frac{3}{4}$ *days*. Again, the coals at the lesser velocity, and taken at 8 lbs. per nominal horse, per hour, will be $\frac{230 \times 8 \times 360}{2240} = 295$ tons for the voyage, and for the greater velocity with both engines, we should have $\frac{460 \times 8 \times 271}{2240} = 445$ tons.

The results then will be as follows:— A saving of 150 tons of coals will be effected, but the voyage would be *prolonged* $3\frac{3}{4}$ *days*, (without reference to the state of the weather.) Therefore, there can be little doubt on which side of the ledger the balance would be, if this mere economy of fuel be compared with the wear and tear of the ship, loss of time, and a host of other considerations connected with the case.

Passing by a lengthy quotation from Kater and Lardner, relating to the laws of motion, we come to a comparison between the *Great Liverpool* and the *Locust*, in which their different *momenta* appear to be assigned as regulating their velocities. The paragraph is obscure, and it is difficult to understand exactly what is meant by it; the last sentence, however, is *very distinct*, and contains another of those fallacies, sufficient to taint the whole navy, could we suppose it capable of imbibing them. It is as follows: (No. 1159, p. 283,) "Multiply, then, the *tonnage* by the velocity, and we find the relative momenta in the cases cited." Now, *tonnage has not the slightest relation to weight:* even the mere apprentice could tell Mr. Hoseason that ships are constantly built of the *same tonnage*, but the one *double* the *weight* of the other; therefore, all those who wish to be accurate in such calculations, must substitute for tonnage, the weight, or displacement, of the vessels referred to.

The two following paragraphs (p. 283) contain a curious mixture of error and conceit. They relate to the *Great Liverpool* having beaten the *Mægara*, and which was predicted by her commander, "because no Government vessel has sufficient horse-power." But, says our author, "singular enough, no one traced the effect to its true cause"—*i.e.*, no one but himself! He has here done great injustice to Mr. Engledue of the *Great Liverpool*, whose prediction was founded on a correct basis. If your readers will do me the favour to read the second paragraph in p. 283, (right-hand column,) and then allow me to tell them that the *collective* power of the *Mægara* is just 130 horses!* and *not* a moiety of that of the *Great Liverpool's*, or 230 horses, they will be fully aware of the value of Mr. Hoseason's facts, without

* There may be a quibble here,—let us, therefore, refer to the last paragraph, p. 283, (No. 1159,) where the author explains what he means by "maximum velocity." As it is a very incomprehensible affair, I must leave each reader to put his own construction upon it, merely observing, that it does not appear to disturb the position I have assumed above. There is another paragraph (No. 1160, p. 294,) which is more to the point; yet, still of a most intangible and contradictory character. I request the reader will compare what Mr. H. has written.

* Engines made by Seaward and Co. Cylinders, 44 in. diameter; stroke, 4·3; velocity of piston=204 ft. per minute. (See Weale's Tredgold, plates 49 and 50.)

entering at all upon the question, as to the ridiculous way in which he handles such subjects.

But, I am almost tired of exposing this gross tissue of false reasoning and data, and therefore pass a luxuriant crop of errors, to notice more than two columns of *chaff* about the *Atalanta* and *Berenice* steam vessels. And, Sir, let your readers search as they please throughout these letters, they will not find anything more absolutely unsound and absurd than the passages I am now about to bring under their consideration.

Who the "certain worthy gentleman" may be, who has disputed the accuracy of the log of these vessels, as published in the *Nautical Magazine*, for 1837, I have no means of ascertaining; be he who he may, he thereby proved his "comprehensive faculties" to be far superior to Mr. Hoseason's, who not only accepts them, but, with his (one?) "idea which flashed instantly to his mind," proceeds to prove thereby the truth of economy by the expansion of steam. Vain hope, delusive expectation! For what was really the case? That the *Atlanta*, which he states, (p. 295,) "consumed on the whole less than the *Berenice*, in proportion to her horse-power," was *not* fitted with expansion gear! but had a *permanent* ratio of expansion given by the sliding valve; whereas, on the contrary, the *Berenice was* fitted with expansion gear, in addition to that of the ordinary sliding valve, and which she used on her voyage, principally, between Mayo and the Cape. As Mr. Hoseason has quoted the *Nautical Magazine*, and its contributor "Mercator," (to whose sterling talent and ability I beg to bear witness,) it is a great pity that he did not consult the volume for 1838, where, in p. 93, *et seq.*, he would have found an article by "Tubal Cain," which, at once, would have relieved him from his speculations on this subject. I annex a copy of that article, in which it is most scientifically and ably demonstrated, that the consumption of fuel on board the *Atalanta* during her passage to India, *was* 9·3 lbs. *per horse, per hour!* not 6·5 lbs. as stated in the log; and that on board the *Berenice, it was* 8·6 lbs. *per hour*, and not 5·8 lbs. And more singular still, that during the passage from Mayo to the Cape, when the *Berenice* used her *expansion gear*, the consumption was 13·3 lbs. per horse, per hour!

Such results were, and are to be, deduced from these authorised and published logs; but how absurd would it be, to draw conclusions from such a basis!

There can be no possible doubt that these logs are totally incorrect, and (for scientific purposes) not worth the paper on which they are printed. There is nothing in them that affects the question of the truth of the theory of expansion, and I refer to them merely to observe, that the man who is unable to unravel and comprehend their fallacies, is most unfit to set himself up as the teacher of his brethren.

In conclusion, perhaps I may be permitted to give Mr. Hoseason some advice; it is this—that he forthwith place himself under the guidanse and instruction of my accomplished and respected friend Mr. Dinnen, of Woolwich dockyard; where, by the exercise of those powers of application and excellent ability with which nature has blessed him, added to the talents of his tutor, and following those *steps* he has hitherto taken, we may yet live to see "his flag at the main." I am, Sir,

Your obedient servant,

PRESSURE NOT PUFF.

P.S.—Chance has brought under my notice, the work of Lieutenant Gordon, which has been quoted, as an authority, by Mr. Hoseason. Although but cursorily examined as yet, it bids fair to yield a rich harvest of criticism.

P. not P.

Appendix to the preceding Paper.

No. I.

Abstract of James Watt's Patents, taken from the Volume of the Institution of Civil Engineers, January, 1845.

1st Patent.

Patent for separate condensation.

1st. Cylinder to be kept warm by steam around it.

2nd. The condenser to be kept cold by the application of cold water.

3rd. Elastic vapour to be withdrawn by an air-pump.

4th. To employ steam to press down the piston in place of the atmosphere, and when water is scarce, to work by it alone by allowing it to escape into the air.

5th. For the rotary engine.

6th. For the working by the alternate expansion and contraction of steam.

7th. For the hemp or other packing.

Enrolled, 9th April, 1761.

Extended by Act 25 years from November 29, 1774.

2nd Patent.

For the sun and planet wheels, and six other plans for communicating motion.

Enrolled, 25th February, 1782.

3rd Patent.

1st. For the theory of expansion with diagram, as copied by Farey, page 347.

2nd. For equalising the power of the steam by chains wound upon one spiral and off another.

3rd. Ditto by means of friction-wheels.

4th. Ditto by causing the centre of the working beam to change its place.

5th. Ditto by changing the position of a weight on the beam, showing three methods.

6th. Ditto for the fly-wheel and sun and planet wheels, with sector on the beam and rack on piston-rod.

Second Improvement for double action.

3rd. For working another engine with steam of the first one—being of course half the power.

4th. For the sector and racks.

5th. For the rotary engine.

Enrolled, 4th July, 1782.

4th Patent.

1st. *For making the cylinder work on an axis, &c.*

2nd. For the parallel motion.

3rd. For balancing the pump-rod and other machinery

4th. For working rolling mills.

5th. *For moving heavy hammers or stampers.*

6th. For the hand gear of the pumping-engine (single action).

7th. For locomotive engines and boilers.

Enrolled, 25th August, 1784.

5th Patent.

1st. For the sloping grate and dead plate for coking the coal, and for a new fire-furnace for consuming smoke.

Last enrolled, 9th July, 1785.

This includes all the patents of Mr. Watt, with the exception of the letter and drawing copying machine patent, which was enrolled, 1780. See Farey, p. 645 (note), for a full account of the invention.

No. II.

Expenditure of Coals in the "Atalanta" and "Berenice."

(From the *Nautical Magazine*, page 93, *et seq.* 1838.)

Sir,—You have favoured the public with the logs of the *Atalanta* and *Berenice* during their passages out to India, and as they have no doubt been read with interest, it is to be regretted that anything appearing like inaccuracy should be found in their details. I allude to the statements of the consumption of fuel, given every two hours with unvarying regularity, whether in fine or foul weather. In the former vessel, about the same quantity appears to have been used, and also with different speeds of the engines. This is very unusual. I have been led to believe that the consumption is considerably influenced by the state of the weather, and the number of strokes of the engines.

In sea passages it is, I understand, necessary to clear out the boiler fire-places at periods more or less distant, according to the quality of coals, on which occasions the grates have to be supplied with an extra quantity of fresh fuel. This process does not appear to have taken place on board either of these vessels, at least the logs do not show any increase of consumption rendered necessary by such an operation. One undeviating regularity pervades the whole of these records, without stating by what means the coals were so accurately ascertained every two hours. If the stokers performed this duty of weighing them, their labour would be increased in a two-fold degree, for the same exertion would be required to weigh as to fire. The seamen would object to such duty. I am therefore led to doubt their being weighed at all, and if so, it follows as a consequence, that little dependence is to be placed upon that part of the log. Besides, I consider the consumption under-stated. There is also a manifest error (whether designed or not I do not pretend to determine) in the results at the end of each portion of the passage, where the quantity of coal expended per hour is divided by 210 and 230 horses to give the consumption in lbs. per horse per hour, without reference to expansion or the reduced speed of the engines, giving erroneously small expenditure per hour.

I question, however, the divisions, and before I offer an example of the above, I will attempt to show the nominal power of the engines in both vessels to be rated too high, and I shall do so by referring to the only standard authority which can be admitted,*

* "James Watt."—That the horse power is equal to 33,000 lbs. raised through a foot space in a minute. And for the nominal power of a steam engine, the area of its piston, in inches, being multiplied by 7 lbs., and by the number of feet it moves per minute, divided by 33,000, shall equal a horse power.

as engine makers of the present day are not very particular about the diameters of their cylinders for the same nominal power, varying them as they happen to be placed in competition with others. This is an undoubted fact. It is therefore well that the public, or those interested, have such authority to fall back upon.

In your November Number, the diameters of the cylinders in both vessels are given, viz.: the *Atalanta's* 54 inches, and 5 feet stroke, and 20 per minute power, jointly, 210. The *Berenice's*, 56 inches diameter, 5-6 stroke, and 18-2 per minute, equal 230 horses.

Now, the *Atalanta's* 54 equal area $\frac{2.290 \times 7 \times 200}{33,000} = 97$ horses each. According to the maker's practice, the steam will be expanded in the cylinder for more than one-third of the length of the stroke; we have therefore to reduce the abeve according to this expansion, viz.: 63 horses during the period of the admission of the steam, and 25-5 horses for the expanded part, equal together to 88½ horses at the speed of 20 strokes per minute. This power must be further reduced according as the velocity of the piston decreases. For example, take any portion of the passage. I have at random taken that from Fernando Po to the Cape, in the above Number for November, where the coals are stated "at 213 tons, time 346 hours, equal 12·3 knots per hour, and equal 6½ lbs. per horse per hour." Now, the strokes of the engines taken out each day, average 16·7 per minute, and as the power at 20 strokes has been shown to be 88½ horses, by proportion, 16·7 will give 74, or jointly 148 horses, and $\frac{12 \cdot 3 \times 112}{148} = 9 \cdot 3$ lbs. per horse per hour, instead of the above 6½. Let the effect produced by this fuel be next examined as regards evaporation, which is the most simple and best test of performance. Assuming that the steam admitted, previous to expansion taking place, to be equal to 1½ lb. above the pressure of the atmosphere, and that it is entirely shut off at 21 inches before the piston reaches the top and bottom of the cylinder, making at the same time due allowances for the waste spaces and passages, we have a content of 56¼ cubic feet per cylinder, or 112½ cubic feet per stroke of each engine of steam 1½ above atmospheric pressure, or 124 cubic feet, equal to the atmosphere. And for both engines = 248 cubic feet per stroke. Then $\frac{248 \times 16 \cdot 7 \times 60}{1,700} = 146$ cubic feet of water evaporated per hour, with 12·3 cwt. of coal, or 11·57 cubic feet per cwt., say 12½ by way of making an allowance for waste and condensation; a very common result, or as the Cornish engineers would term it, a very small duty.

With regard to the power of the engines of the *Berenice*, the cylinders being 56 in. diameter, and the strokes 18·2 per minute, we have 56 = area $\frac{246 \cdot 3 \times 7 \times 200 \cdot 2}{33,000} = 104\frac{1}{2}$ horses each. Assuming the steam to be expanded for 22in. of the length of the stroke, we have 69·54 horses for the power during its admission, and 28·16 for the expanded portion, equal together to 97·7 horses each, or 19·54 for both engines, at 18·2 strokes per minute.

From the Mauritius to Bombay, the average strokes per minute equal 14·4, and as 18·2 : 97·7 :: 14·4 : 77¼ horses = 154½ jointly. Coals stated at $\frac{11\text{cwt. } 110\text{lbs.}}{154\frac{1}{2}} = 8 \cdot 6$ lbs. per horse per hour, instead of 5·8 lbs. given in the log.

The effect of this fuel may be got by following the same method as that adopted for the *Atalanta's*, and making similar allowances, we have 136·55 cubic feet of steam, expanded per stroke for both engines, or 300 cubic feet of atmospheric density. Then $\frac{300 \times 14 \cdot 4 \times 60}{1700} = 152\frac{1}{2}$ cubic feet of water evaporated per hour with 11cwt. 110lbs. of coals, or 12·7 cubic feet per cwt., say 13·0 cubic feet as an allowance, as in the former case, for waste and condensation.

These calculations, I have to observe, are made upon the presumption that the makers have followed their usual mode of expansion; the results will therefore be more or less correct, as I may have hit the degree used.

In the *Atalanta*, I understand it was effected by the slide valve alone, but in the *Berenice* a separate means was provided, so that the steam might be cut off from the cylinders at any portion of the stroke. Notice is frequently taken of this being so done to a quarter, and even a half of the stroke, as in the portions of passage from Mayo to Fernando Po, and from thence to the Cape; during which the latter extent seems to have been employed, while the average number of strokes is 13·66 per minute.

Now with this expansion and speed, we have only a nominal power for both engines of 133 horses, with an expenditure of fuel of 15·86 cwt. per hour, then $\frac{15 \cdot 86 \times 112}{133} = 13 \cdot 3$ lbs. of coal per horse per hour, instead of 7¾lbs.

When my attention was first drawn to these logs, and the results therein stated, I was under the impression that more heat had been obtained out of a pound of coal than

had before been established; but on going into the particulars, I discovered the inaccuracy of them, and was led to conclude besides, as I do still, that the consumption is under-stated, particularly in the *Atalanta's* case. Many of your readers, I doubt not, have taken the statements for granted. If you consider these observations will tend to enlighten them, or lead others to throw more light upon the subject than I have been able to do, your insertion will much oblige, Sir, your obedient Servant,

TUBAL CAIN.

NOISELESS DOOR FASTENING.

Sir,—The noise inseparable from the common fastening for doors and its liability to get out of order have induced me to send you the accompanying sketches of a plan, which I humbly think your readers will find, obviates both these annoyances.

Fig. 1.

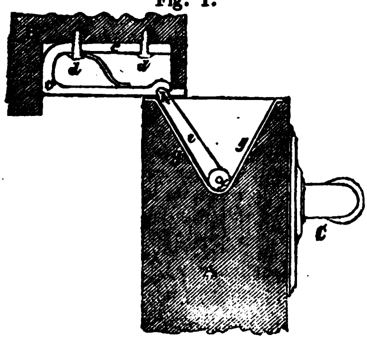
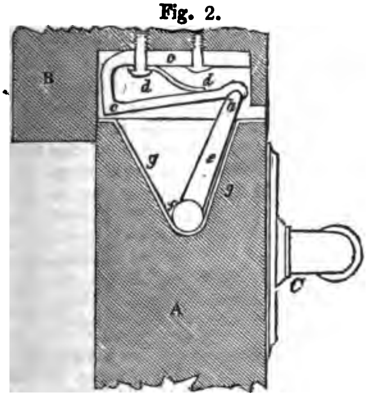


Fig. 2.



Figs. 1 and 2 are horizontal sections of the catch, through *a b*, fig. 3. Fig. 3, longitudinal elevation.

A represents the door; *c c*, a spring fastened by the screws *d d*, to the door-cheek B; C, a handle and plate fastened to the door; *e*, a bar of steel working on the centre *f*, in the box *g g*, and acting as the catch.

Fig. 3.

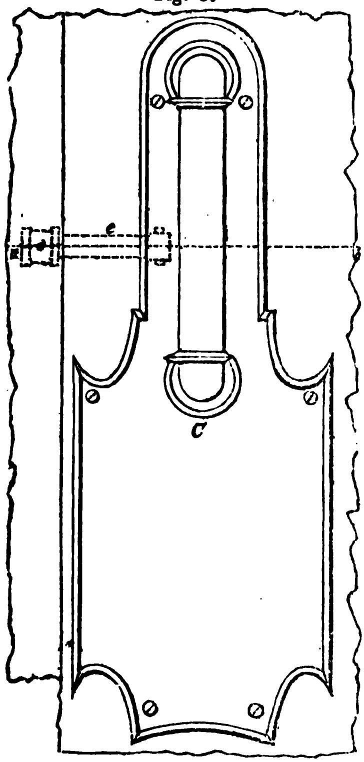


Fig. 1 shows the door nearly shut; the bar *e* has just entered the groove *h*, in the spring *c c*; on pushing it closer, the spring bends, and when the door is quite closed, it has relaxed a little, thus forming a fulcrum for the bar, which should be just sufficient to prevent the door being blown open by the wind. The door is opened by pulling the handle C, and shut by pressing against the plate, the convenience of which will at once suggest itself.

This fastening is not suitable for outer doors, because any one might enter unobserved, but only for inner, where, I think, all will admit, that a noiseless fastening would be preferable.

If you think the above plan any improvement, its insertion will oblige me.

December 11, 1845. UTILITAS.

THE CIRCLE'S PERIPHERY.

Sir,—Reading in your Magazine, p. 368, December 6th, 1845, an article on the *circle*, by Mr. W. S. V. Sankey, reminded me of old John Ward. So, dusting from my shelf his volume on Mathematics, I have re-read his chapter on the circle's periphery, which he entitles, "A new and easy method of finding the circle's periphery to any assigned exactness (or number of figures) by one equation only." He continues, "I shall here propose a new method of my own, whereby the circle's periphery, and consequently its area may be obtained; infinitely near the truth, with much greater ease and expedition, than either that of *bisection* or that of Libnitius, or any other method that I have yet seen—it being performed by resolving one equation, deduced by an easy process from the property of a circle, (*known to every cooper,*) which is this, viz., 'The radius of every circle is equal to the chord of one-sixth part of its periphery.'" He previously observes, "Let us suppose the circle's area to be composed or made up of a vast number of plain isosceles triangles, having their acutest angles all meeting in the centre's circle. But how to find out the sides of a polygon, (viz., the bases of these isosceles triangles,) to such a convenient smallness as may be necessary to determine and settle the proportion betwixt a circle's diameter and its periphery, (to any assigned exactness,) hath hitherto been a work which required great care and much time in its performance, as may easily be conceived from the nature of the methods used by all those who have made any considerable progress in it, viz., Archimedes, Snellius, Hugenius, Mœtius, Van Culen, &c. These proceeded with the *bisecting of an arc*, and found the value of its chord to a convenient number of figures at every single bisection, repeating their operations until they had approached to the chord designed."

Perhaps, Mr. Editor, the above extracts may excite the attention of some of your readers to John Ward's work—and perhaps your correspondent, Mr. Sankey, may bring to bear his talent on Ward's plan, and improve thereon. Of Van Culen's labours, Ward writes, "I say, whoever duly considers the trouble of these, so often repeated extractions, will, I presume, be pleased with what I have done. For, truly, when I consider the great time and care required in them, I cannot but admire at the patience of the laborious Van Culen, who proceeded that way until he had found the circle's periphery to thirty-six places of figures, to wit: (diameter 2). Circumference

6,283185307179586476925286766559005 76."

These numbers are said to be engraven upon his tombstone, in St. Peter's church, in Leyden, for a memorial of so great a work. Yours, &c., J. M.

Battersea, Dec. 10th, 1845.

APPLICATION OF ELECTRO-MAGNETISM TO RAILWAY PROPULSION.

Sir,—If the following scheme be not new, those who have laid it aside have seen more fatal objections to its practicability than I do. Some time ago experiments were tried, with regard to the application of electro-magnetism to propulsion on railways; the result of these were highly satisfactory in establishing the efficiency of the mechanical action of the machines, and the usual railway speed was proved to be maintainable; but the grand objections were the weight of the galvanic batteries requisite for sufficient energy,—their expense, and the fact that this mode of propulsion, as well as the steam locomotive, required the motive power to be carried with the load moved.

Now, suppose we have a railway ten miles long, and that at one terminus there is placed an enormous stationary galvanic battery; might we not make the rails themselves the conducting lines of the battery? And the wheels being so arranged, as to break the connexion where required, a rotating magnet might revolve by the electro-magnetism thus communicated. The first question which is immediately suggested is, how much of the galvanic current would escape by the earth, across the rails? Now, surely if half the trouble that has been expended on the valves of the exhausted tubes of atmospheric railways, were to be employed here, we should soon have some

method of cheap insulation invented. Imbedding in wood prevents a great deal of this loss, and this difficulty seems to me the only one.

Of course the axles of the wheels of the train must be of some non-conducting substance; they might, like the wheel tyres be of wood. Perhaps some fertile brain may take the hint and bring forth soon the "Electric Railway."

I remain, your obedient servant,

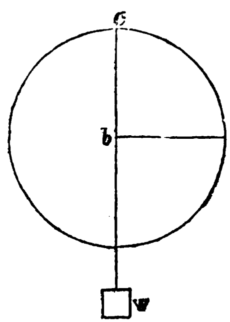
J. M.

Trinity College, Cambridge, December 11, 1845.

THE CRANK.

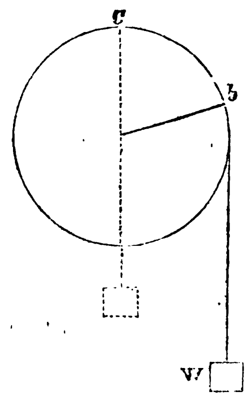
Sir,—With your permission I will endeavour to point out the fallacy of the experiment made by "N.," and described in vol. xli. page 233.

"N." is, doubtless, aware that a weight suspended by a string will have the same effect wherever upon that string's length it may be suspended.



Referring to the diagram, W will have the same effect to turn the wheel wherever it may be placed in the string's length. Place it then at C, fast to the rim of the wheel, it will surely exert the same pressure. Let now the wheel turn to the lowest point, it will reascend *nearly to the top.* Illustrations—A church bell in full swing, supposing the weight collected at the centre of gravity; or any small hand-fly, the handle being fixed on the rim; or the weighted driving wheel of a locomotive, if between centres in the turning lathe. Why then do not "N.'s" experiments show the same result?

Because, the weight in its movement downwards also acquires momentum to the right hand, and (on account of the



non-rigidity of the string) continues its motion to the right hand *in opposition to* the motion of the point of suspension *c*, *to the left hand.* This retardation is the chief cause that the point, *c*, will not return above the level of the centre, and why it fails to give the same result as the first case I mentioned.

In answer to the queries of "Looker On," vol. xlii. page 54, I would say, 1. There is no loss of power by the intervention of that mass of metal called the crank *when* there is considerable friction in the engine. And,

2. That it does not matter what friction be calculated, whether that which is intrinsic to the engine and crank-shaft journals; or the total of that and the friction in connexion with the work done.

I have the honour to be, your humble servant,

IRATUS.

August 15, 1845.

MALLET AND NASMYTH.—ATMOSPHERIC RAILWAY.

Sir,—Seeing that you are to publish Carson's patent specification, allow me to ask a question or two about it. In what respect does fig. 7 differ from the well-known blast-pipe of locomotive engines?

Not in the slightest particular, except in its position on the paper!

And as to fig. 8, it is *the same* as Barry's application of the principle of steam vacuum to distillation, patented May the 24th, 1819.—(*Repertory*, vol. xxxviii., p. 257, and Ure's Dictionary of Chemistry, p. 454.)

Carson's patent is therefore invalid:

but even if it were not so, it is evident on reading the specification, that he never dreamt of atmospheric railways when he took out his patent.

From the evidence before us, Mr. Mallet is most undoubtedly *the* original and *first inventor* of *the application* of the well-known principle of *steam vacuum to atmospheric railways*. This is all that he claims, but unfortunately for him, he was not the first *publisher* of it. It appears that Nasmyth's specification was enrolled on the 22nd of April, 1845; while Mr. Mallet's paper was read at the Royal Irish Academy, on the 26th of May, 1845, but deposited there on the 13th of November, 1843. From this it would appear that Nasmyth and May's claim to "the mode of obtaining vacuum in the traction pipes of atmospheric railways, as herein described," *Repertory*, vol. v., p. 345, was perfectly valid, Mallet's invention being *a secret* till after their patent was sealed.

Mr. Mallet also appears to claim, as his invention, the producing the vacuum in the working tube not directly, but *by the intervention of large reservoirs previously* vacuous, but states that this was *published* prior to the reading of his paper, by Mr. Roberts at the Cornwall Polytechnic meeting, of 1844. The following is the extract referred to by Mr. Mallet, from the *Mining Journal*, of August 31, 1844:—

"A model of an atmospheric railway was exhibited by C. Roberts, Esq., in which were several new arrangements, particularly of the valve; it ascended an incline of one in twenty with ease, and several gentlemen took a trip on it—this is a gradient which cannot even be attempted by any railway engine yet introduced. Instead of using a heated iron for the purpose of dissolving the composition to seal the valve, he uses a vertebrated valve, which most completely forms the vacuum, without any composition whatever; he can also stop or control the propulsive power, a flexible piston arm preventing the possibility of excessive friction taking place. He thus removes the great objection raised by Mr. Robert Stephenson, in his evidence before the committee of the House of Commons. By employing larger receivers, in proportion to the size of the propulsion tube, he can procure more rapid exhaustion, close the valve, and start the train at a moment's notice.—The Judges awarded Mr. Roberts the society's silver medal for these inventions; and, though they expressed some doubt as to the superiority of a jointed metallic valve, covered with leather, being superior to that used by Messrs. Clegg and Samuda, further investigation since the meeting has fully confirmed its merits."

I hope I have rendered the position of each party more clear than it was.

R. S. NEWALL.

Gateshead, Dec. 15th, 1845.

CARSON'S PATENT.

On looking into the specification of this patent, about which there has been a recent correspondence between Mr. Dircks and Mr. Mallet, we do not see that there is any occasion for publishing it entire, as requested by Mr. Mallet, (p. 407,) for there is but a small portion of it which bears upon the point at issue. We shall, however, extract all that is necessary.

The title of the patent is "for improvements in apparatus for withdrawing air or vapour."

Mr. Carson observes, by way of introduction to his specification: "My invention relates to certain apparatus for removing air from a chimney or other shaft; *first*, by means of draughts induced by means of the outer atmosphere; and, *secondly*, by means of steam." He then describes five different sorts of apparatus.—The first is "intended for a chimney, or other shaft, for withdrawing air therefrom,"—and consists of "a revolving head," of a peculiar construction. The second and third are modifications of the first. In the fourth, (fig. 7,) a draught is produced by means of a "steam-pipe, through which the steam is to be constantly flowing;" which steam-pipe "passes beyond the opening of a pipe *d*." (leading to the chimney or shaft, or other place from which air is to be withdrawn.)—"Consequently, the passage of the steam through it, will so act as to produce a draught or current, &c. The fifth, which furnishes the only matter for dispute, is thus described:

"Fig. 8, shows another apparatus, co[nstructed] according to my invention, an[d] to be worked by a vacuum produced by condensation of steam, *f*, is a shaft or pi[pe] in connection with a mine, or house, [or] other place, from which it is desired to wi[th]draw air. On the upper part is applie[d a] valve opening upwards. *g* is a vessel, i[nto] which the pipe, f^1, *enters*, consequen[tly] any air which passes from the pipe way, will flow through f^1 into the vessel *g*,

when steam is admitted into the vessel *g*, the air therein will be driven out at the opening and valves *h*. This vessel is supplied with two pipes, one by which steam is allowed to flow into the vessel *g*. I prefer to use high pressure steam, and to cut it off at such a position, that in expanding it will fill the vessel *g* with atmospheric steam; but I do not confine myself thereto.

The other two pipes lead to a condenser, and there are stop-cocks on the steam pipe and the pipe which leads to the condenser, which cocks are to be alternately opened and shut. Thus, supposing steam had been allowed to flow into the vessel *g*, and was closed, the cock on the pipe leading to the condenser would be opened, by which the steam would rush away and be condensed, and there would be a vacuum produced in the vessel *g*, but that the valve on the passage opens, and air flows into, and fills the vessel *g*; the cock on the pipe to the condenser would then be closed, and the cock on the steam pipe would be opened, by which steam would again flow into the vessel *g*, and drive out the air therefrom by the air-valve. And by this arrangement a very cheap apparatus for using steam, as a means of withdrawing air, will be obtained."

Mr. Carson's claim, as regards the fifth mode, is in these words:—

"Lastly, I claim the mode of constructing apparatus to be worked by steam and condensation, as described in fig. 8."

Our opinion (which we add as requested) is, that Mr. Carson did not contemplate the application of his mode of producing a vacuum by the condensation of steam to atmospheric railways; but that such an application of it might have been validly included within the words of his title: and that had he specified it in express terms, no one after him could have established a legal claim to it.—Ed. M. M.

PRIMING.

Sir,—Having constructed a small high-pressure boiler for experimental purposes, as I found it to answer in most respects, there is but one circumstance that prevents it realizing my most sanguine expectations, and that is, that it "primes" to such an extent at times as not only to prevent the engine from working satisfactorily, but even from working at all. The boiler is an upright tubular one, about 4 feet 6 inches high and 18 inches diameter; it contains twenty-two 2-inch iron tubes 3 feet 6 inches long, the tubes being ⅜ths of an inch apart. I have tried every means in my power to prevent the evil complained of, but without effect, such as the insertion of oil, lime, and melted tallow, &c., into the boiler, and working the water very low, both river and spring, but the evil still exists. If, by the insertion of the above in your valuable journal it should produce a discussion among your numerous correspondents on this imperfection, common to most boilers, I think it would be of great service to engineers in general, but more particularly to,

Your most obedient servant,

W. H.

December 12, 1845.

EXPERIMENTAL STEAM FLEET.

It is reported that an experimental squadron of steam-vessels will put to sea to try their repective rates of sailing and steaming, and other features, as efficient and serviceable vessels of war, early in the ensuing spring, and that gunnery exercises will be a leading object of their trials, in order to ascertain which armament is best adapted for vessels of their class. The competing vessels named are the—

Vessels.	Tons.	Horse Power.
Terrible	1,847	800
Retribution	1,641	800
Avenger	1,444	650
Gladiator	1,167	430
Samson (frigate)	—	450
Ardent (sloop)	—	200
Rattler (screw)	888	200
Scourge	1,124	420
Black Eagle	495	260

INTERESTING PHENOMENON CONNECTED WITH THE AURORA BOREALIS—A SPECTRE RAILWAY.

Sir,—During an active display of aurora borealis, in the evening of Wednesday, the 3rd instant, a very interesting phenomenon was observed in connexion therewith; it presented the appearance of a white, luminous, well-defined arch, spanning the hemisphere to the extent of about 160 degrees; commencing below the stars Castor and Pollux, and passing through the intermediate sign of the Zodiac to Aquarius in the vicinity of the planet Saturn, its course being nearly parallel with the ecliptic; and from the position of that circle at the time (8 to 9 o'clock) it was nearly at right angles to the magnetic meridian. Is it not very probable that the aurora supplied the matter for the formation of this beautiful arch?

The present era being so very rife in rail-

way projects, the mind immediately became strongly associated with the significant terms *broad guage, narrow guage, scrip, atmospheric principle, &c.*, and I could not help fancying that I saw a phantom railway in the atmosphere, a project of "Old Atmos, and Co.," for the creation of a new scrip for the share brokers, a scrip that would possess the peculiar advantage of not involving their customers in any pecuniary losses, and consequently, of far more value than some of that description of property on *terra firma*. The breadth of our spectral railway varied from about 2 to 4 degrees, showing that the advantages of broad guage, or narrow guage, is a question mooted by the celestials, as it is by the mundanes.

It appears from notices of this singular phenomenon, in the provincial newspapers, that it was an exhibition for all the county of Norfolk, at least: and it is worthy of remark, that the direction assumed by our phantom railway very nearly coincided with the projected line between Lynn and Fakenham; and I would say to the projectors and provisionals of that line, Despair not, gentlemen—I saw a spectral plan and sections of your railway in the heavens, which I take to augur favourably for the ultimate success of your line,

Yours truly,

J. Loose.

December 13, 1845.

ON THE POTATO DISEASE. BY ANDREW URE, M.D., F.R.S.

The vague and contradictory statements concerning the nature of this calamitous visitation of Providence, as well as the directions for the treatment and preservation of the tubers, generally impracticable and preposterous, which have recently issued in vast variety from the press, do little honour to economic chemistry. It is needless to notice all the notions and schemes which have either officially or spontaneously been projected. Only two of these deserve comment; the first, as coming from a great master in science; the second, as emanating from the Irish commissioners.

Professor Liebig imagines the essence of the disease to consist in the conversion of the albumine, a usual constituent of healthy potatoes, into caseine, a principle which, by its great instability of composition, is supposed to cause the potato to putrefy rapidly. I have subjected this opinion to the test of experiment. Perfectly sound potatoes, as also diseased ones, were sliced or grated, and separately digested in a very dilute alkaline ley at a blood heat. The infusions, when cool, being filtered and faintly acidulated with dilute acetic acid, afforded respectively a like proportion of caseine-looking flakes. It would thus appear, from this mode of testing, as prescribed by M. Dumas in the seventh volume of his "Traité de Chimie," that *sound* potatoes contain as much as *unsound*.

Professor Liebig's plan of preserving diseased potatoes is founded on the above notion, and consists in cutting them into slices one quarter of an inch thick, and steeping them twenty-four or thirty-six hours in dilute sulphuric acid. On this proposal I need make no comments, as it has no chance of being practised beyond the precincts of Giessen.

In the *Pharmaceutical Journal* for October last, I inserted a few observations on diseased potatoes, chiefly with the view of showing, that till the putrefactive stage commences, the potato had the same acidulous reaction as in the sound state, but that *then* a portion of ammonia made its appearance, as was proved by its alkaline action on litmus paper, and by its coming over in distillation. That brief notice was written while I was at a distance from home on professional business, and where I had no means of prosecuting my experiments. At my first period of leisure since, I resumed my inquiries, and have obtained certain results which may probably be found useful, as well as interesting.

Before entering into a detail of them, I shall shortly describe the constituents of sound potatoes, according to the most authentic analyses. Their average composition in 100 parts, according to Einhof and Lampadius, is—fibrous matter, 7; starch, 15; vegetable albumen, 1; gum, acids, and salts, 3·5; water, 75. Besides these principles, Vauquelin, by his older and more minute analysis, discovered the following in minute quantities:—crystallizable asparagin; an azotised substance resembling gum; a resinous matter emitting an agreeable odour when heated; an extractive matter which blackens in the air; citric acid; citrates and phosphates of potash and lime.

* * * * * *

The nutritious quality of potatoes resides chiefly in the starch, fibrine, and albumen; the latter being essential to the formation of blood.

* * * * * *

In the diseased potatoes, a portion of starch is transformed into sugar, and of albumine into an acrid offensive brown substance. If such tubers as are characterized by brown spots in the interior, and a thickened brown skin, both composed of fungous fibres, be grated or sliced, and exposed to pressure, either alone or with a little te

water, the juice obtained will be found to have a mawkish sweet taste, followed by a sense of pungency on the tip of the tongue. If some of this juice be mixed with a little of Trommer's grape-sugar test (an alkalized solution of sulphate of copper,) this blue-coloured mixture will change into a bright orange hue, slowly, in the cold, but rapidly on application of a gentle heat, with a deposit of protoxide of copper. By means of a modification of that test, described by me in the *Pharmaceutical Journal* for July, 1842, I have ascertained the existence of about five per cent. of saccharine matter in diseased potatoes; yet by the same re-agent, which is sensible to $\frac{1}{100}$th of a grain of sugar, I could observe none of it in perfectly sound potatoes. After satisfying myself in this way as to the presence of sugar in diseased potatoes, I proceeded to verify the fact by placing their expressed juice, as also their infusion, in contact with a little yeast, at a fermenting heat of from 80° to 90° Fahrenheit, and watched the resulting phenomena. A fermentative action soon began, and in an hour or two became so brisk as to throw up a thick, creamy froth, like that occuring with small-beer wort. At the end of thirty-six hours, the liquor having considerably diminished in specific gravity, was subjected to distillation, and yielded alcohol equivalent to about four per cent. of sugar in the potato.

* * * * * *

The vinous spirit produced is by no means disagreeable in taste or flavour, and may be easily rectified into excellent alcohol, fit for every purpose of arts, manufactures, and pharmacy. Were it not for the oppressive laws of the excise, sufficient alcohol might thus be obtained this season, for the uses of a temperate people, reserving an equivalent portion of grain from the whisky manufacture for their sustenance. The residual cake of the diseased potato is well adapted for feeding cattle, the morbid juices having been separated, and it may be so dried as to keep unchanged for a moderate length of time.

In all the diseased potatoes which I have examined with the microscope, the fibres of a fungus called *botrytis* from its grape-like form—or of one called *uredo tuberosum*, *may* be observed ramifying round the cells which enclose the starchy corpuscles. Now these plants, however minute, are not self-generated, but must be produced by some seminal impregnation transported by the atmosphere, and peculiarly adapted to fructify upon the *solanum tuberosum*. I would hence conclude, that the potato disease is a peculiar vegeto-pestilence, diffused generally through the atmosphere, whose ravages have been favoured by the sunless humidity of the last season as the predisposing, but not as the exciting cause. The proximate cause again, in medical language, or the essence of the morbid state, is the fungus inmate of the tuber, from seminal impregnation of the stem, which so paralyzes the vitality of the plant, that a portion of the starch and albumen becomes decomposed. This vegetable distemper, like that of the cholera, while general in its diffusion, is determined to particular localities and plants by certain predisposing causes; yet it is independent of these, having occurred in many regions where such causes did not materially operate. Whether it will recur, no human being can predict; meanwhile, it reads a great and solemn lesson to the rulers of states, never better expressed than in Virgil's well-known verse—

"Discite justitiam moniti, et non temnere divos;"

which may be translated, "Beware of obstructing the free supply of food to your people."

Many preposterous prescriptions have been obtruded on the public eye as to the best method of preserving the diseased potatoes from putrefaction. The above researches show the existence of a highly fermentable saccharine and albuminous matter in them, which becomes rapidly operative by contact with air and moisture. Care should therefore be taken to keep their skins entire, so as to exclude the atmospheric oxygen and humidity. It is well known that the sugar in ripe grapes undergoes no change while the skin is entire, but the moment this is pricked, the grapes begin to ferment, and speedily spoil. No plan is therefore more to be deprecated than that of slicing and mashing potatoes. They should be placed in an atmosphere kept by chemical means in a state of extreme dryness, which may be easily and cheaply effected by piling them upon a bed of brushwood, dry turf, or straw, interspersing through the pile unslacked lime coarsely bruised, and covering the pile thoroughly at the sides and on the top from the external elements. Since unslacked lime absorbs greedily one third of its weight of moisture, it will bring the air in the spaces between the tubers into a perfectly arid state—a condition in which no decomposition of the substance can possibly take place. On the same principle, highly-polished steel articles may be kept for any length of time without tarnishing in our humid climate, provided a basin with lumps of unslacked lime be enclosed in the case or chest containing them. Slacked lime, on the contrary, being saturated with water, has no power of desiccation, but acts only by its causticity in favouring the destruction of all vegetable and animal matter.

Charlotte-street, Bedford-square, Dec. 9, 1845.

The Lancet.

NOTES AND NOTICES.

The Wonder and Fairy.—The *Jersey News*, speaking of the late trial of speed between these vessels, observes, "The nature of this contest will be better understood when it is mentioned that in anticipation of this trial Her Majesty's vessel had been prepared in dock, that the wind being a-head and the tide against her, she had the advantage of a light draught of water, and the entire absence of top hamper, compared with the large paddle-boxes and greater depth of her rival, in addition to which, the *Wonder* was taken without preparation from the Quay-wall, and with her bottom in a state that retarded her at least one knot in the hour. Yet in the face of all this, she most triumphantly maintained her well-acquired character—that of being the fastest steam-craft afloat. "Honour to her, and prosperity to her owners."

Steam Navigation of the River Amazon.—We some time back stated, that attempts were making by the Americans, to run up the river Amazon by means of steamers. From further particulars we have received on the subject, it appears that four steam-boats were built in the United States for that purpose. When they arrived at Neustra Senora de Loretto, a port on the limits of the Brazils and Peru, they there found the *American*, Captain Clause, who had come from Lima to take command of the expedition. Captain Clause, on board of the *Peruvian* steamer, of 140 horses-power, ascended the river as far as the mouth of the river Guallaga, and afterwards in a boat, accompanied by 350 Indians, which number he progressively increased to 700. He then ascended the Guallaga, as far as the village of Tingo, situated in Peru, and seven days' travelling from Lima, when he was able to have the current of the river cleared of all obstacles which might impede the progress of the steam-boat. That accomplished, he returned to Loretto, and brought the steamer up the Guallaga to the said village of Tingo, whence he despatched an express to Lima. The commercial house which is at the head of this enterprise, gave orders to Captain Clause to explore the river Gastoza, another branch of the Amazon, as far as it was navigable for steam-boats. He found this river perfectly navigable as far as the village of Andoea, situated on the limits of the republic of Peru and the equator. Thence he went by land to Quito. In the course of this exploration he discovered several mines of sal-gomma, and very extensive silver and platina mines. He was quite surprised at the mass of riches the countries he passed through contain, consisting chiefly of valuable mineral ores of various descriptions, timber for building, and dying woods, coffee, cocoa, cotton, spices, balsams, resins, wax, and a great number of other produce of the highest importance.—*Mining Journal.*

A Railway Race.—A railway race is a sufficiently exciting and interesting event; but it is rarely witnessed, and scarcely ever in perfect safety. Between a pair of well-matched locomotives it would be sufficiently exciting; but between a new system, like the atmospheric, and its rival, the locomotive, the character and reputation of both systems for speed depending on the issue, a well-matched contest would be of no common interest. In this case we were lucky enough to see such a race; and we believe that any of our readers who leave London-bridge station at twenty minutes past two, and take an atmospheric ticket, may do the same. We were standing at the Forest-hill station, preparing to start, when it was announced that the Dover express train was in sight! Immediately we (the atmospheric) made preparations to start, and were just in the act of starting from rest when the locomotive train "whisked" past us at, probably, some thirty-five miles an hour. We started, but before we got into motion at any velocity, the Dover train was a mile a-head of us, and was evidently gaining rapidly in speed. However, on we went like a whirlwind, and it soon became evident we were gaining on our rival. Three or four minutes decided the race. We passed the express train at a rate exceeding her own by fifteen or twenty miles an hour. Our velocity could not be less than sixty miles an hour. It was easily and steadily maintained, and we were over the Brighton viaduct and considerably beyond it before the Dover reached it. But considerably before this time the brakes were put on, and the vacuum destroyed by the valve, to avoid danger in running upon the workmen round the sharp curves; and when we reached Croydon, in six minutes and three quarters, it was found that the journey, as a whole, had occupied more time than it has frequently been performed in.—*Railway Chronicle.*

The Steam Pile Driver. We extract the following account of the performances of this powerful machine, from a letter of its modern resuscitator, Mr. Nasmyth, to the *Mining Journal.*—The steam pile driver, at Devonport, has already completed its great job,—namely, the vast coffer dam required for the construction of the great dock (of sixty acres) which the Admiralty are forming there, for the accommodation of the vast steam navy about to be called into existence. This coffer dam is of unprecedented dimensions, being 1650 feet in length, by 20 feet wide,—and formed by three rows of piles, 14 inches square, from 50 to 65 feet in length, driven perfectly close together. The steam pile driver has executed this great work in the most masterly style, and with a degree of rapidity and perfection never before attained. In the enormous number of piles driven by it, not one has been split; while, at the same time, they have been driven into depths of soil, which was otherwise unattainable by the ordinary system. The whole of this great work has been executed in defiance of many impediments, since the latter end of June; and the last duty the steam pile driver had to do, was to test its power upon several piles which had been driven to the very utmost limits of the power of the old system machines. These it was brought up to, and set to work on; and, with a few of its masterly blows, sent them down into the hard soil to further depths, varying from 3 to 9 feet; thus demonstrating, in the most convincing manner, the superior powers of the steam over the ordinary pile driver.

The Lunar Rainbow is a much rarer object than the solar one. It frequently consists of a uniformly white arch, but it has often been seen tinted, the colours differing only in intensity from those caused by the direct solar illuminations. Aristotle states that he was the first observer of this interesting spectacle, and that he only saw two in the course of fifty years; but it must have been repeatedly witnessed, without a record having been made of the fact. Thoresby relates an account received from a friend, of an observation of the bow fixed by the moon in the clouds, while travelling in the Peak of Derbyshire. She had then passed the full about twenty-four hours. The evening had been rainy, but the clouds had dispersed, and the moon was shining very clearly. This lunar iris was more remarkable than that observed by Dr. Plot, of which there is an account in his *History of Oxford*, that being only of a white colour, but this had all the hues of the solar rainbow, beautiful and distinct, but fainter. Mr. Bucke remarks upon having had the good fortune to witness several, two of which were, perhaps, as fine as were ever witnessed in any country. The first formed an arch over the vale of Usk. The moon hung over the Blorenge—a dark cloud was suspended over Mayarth—the river murmured over beds of stones; and a bow, illumined by the moon, stretched from one side of the vale to another. The second was seen from the castle overlooking the Bay of Carmarthen, forming a regular semicircle over the river Towy. It was in a moment of vicissitude, and the fancy of the observer willingly reverted to the various soothing associations under which sacred authority unfolds the emblem and sign of a merciful covenant.—*Globe.*

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 1168.] SATURDAY, DECEMBER 27, 1845. [Price 3*d.*

Edited by J. C. Robertson, No. 166, Fleet-street.

MESSRS. TAYLOR AND SIMPSON'S IMPROVEMENTS IN PROPELLING.

Fig. 3.

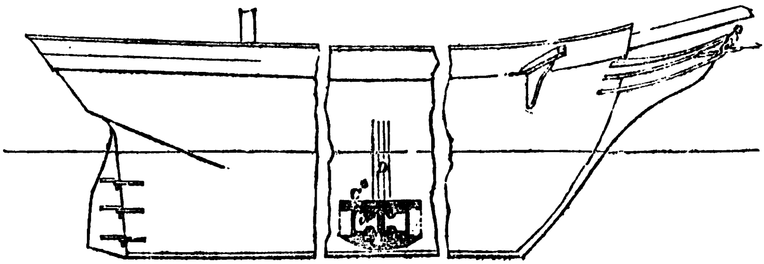


Fig 1

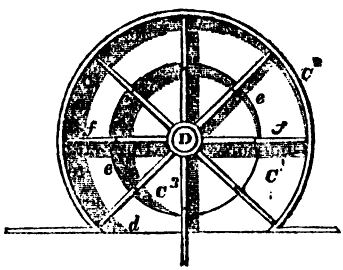


Fig 2

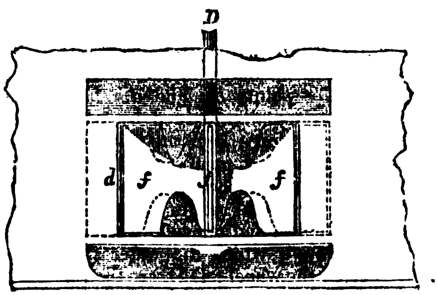


Fig 5

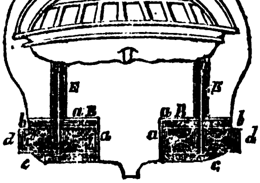
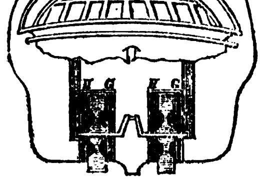


Fig 8



MESSRS. TAYLOR AND SIMPSON'S IMPROVEMENTS IN PROPELLING.

We noticed last summer a very promising experiment, which was then made on the Regent's Canal, (afterwards repeated, we believe, on the Grand Junction, with equal success,) with a steam-boat fitted with a submerged propeller, invented by Captain W. H. Taylor. Some improvements have been since made by Mr. T. B. Simpson; and we extract from the Specification of the Patent, taken out in the joint names of these gentlemen, the following description:—

Fig. 1, is a plan of the propelling apparatus, and fig. 2 an external elevation of the same, being shown in both these figs., detached from the vessel to which it is to be applied. Fig. 3, a side elevation of a vessel with the propelling apparatus, as shown in figs. 1 and 2, applied to it. In the centre of the vessel there is a rod as usual, appropriated to the engines, by which the paddle-wheels are to be propelled. B B are two recesses for the paddle-wheels, formed in the sides of the vessel, under the water-line, which are parted off from the rest of the vessel, by water-tight partitions, *a a*, and have openings to the external water, at the points *b c* and *d*. Each recess is horizontally divided by partitions *e e*, into three separate compartments, namely, a central compartment marked C^1, within which the wheel revolves in a horizontal position; and two others, one above and one below, marked C^2 C^3, through which the water flows into or from the wheel; D D, are the vertical axes of the wheels which are stepped in suitable bearings in the floor of the vessel, and are carried upwards through hollow trunks or cases, E E, which reach above the water line. Each axis is stepped at such a point within the recess, that when the wheels revolve, the floats *f f* shall successively project a little way beyond the outsides of the vessel. Where the shafts pass through the partitions, *e e*, which separate the upper and under compartments C^2 C^3, there are open spaces all round them to allow of the water flowing into and from the centre of the wheels. The length of the side openings *d*, should not be less than about one-sixth, or more than about one-third, of the circumference of the wheel. The necessary rotary motion is communicated to the shafts from the engine by means of wheel gearing, which being of the same description as that commonly used for such purposes is not represented in the drawings. On motion being given to the wheels, the floats are successively protruded into the water one at a time, and each at that point of its circle of revolution where it is capable of exerting its greatest useful effect. The water at the same time keeps continually rushing through the top and bottom openings *b c*, and the open spaces round the shafts D D, into the centre of the wheels, whence it is expelled sternwards through the side openings *d*. The floats may be of the form, and fixed in the manner shown in fig. 5; or of the form, and fixed in the manner shown in fig. 5*a*; or of any other suitable form, and fixed in any other suitable way.

Another arrangement on the same principle as the preceding is represented in the plan fig. 4, of the drawing hereunto annexed. M is a water-trunk, made in the bottom of the vessel, extending from side to side, and parted off from the rest of the vessel by water-tight partitions, *w w*, the floor of the vessel serving as the floor for this trunk. N N are two circular cases, appropriated to the paddle-wheels, which are raised on the bottom of M, and project through openings, *m m*, (the ends next the water fitting tightly into these openings,) to such an extent that the length of the openings shall (as before) be not less than about one-sixth, nor more than about one-third of the circumference of the cases. Where these cases project from the vessel, they are open at the sides only to the water; but on the inside, all round, from *r* to *s*, they are closed and shut off from any communication with the water-trunk M, except through orifices P P made in the tops of the cases round the paddle-wheel shafts. The water-trunk, M, is perforated in those parts of the bottom of it not covered by the paddl wheel cases with holes, for the admissio of water from the outside of the vesse and being by this means kept constant full, the water flows over through t orifices, P P, into the centres of t wheels, whence it is expelled throu the open side of the paddle-wheel cas Instead of the floor of the water-tr M serving for the floor of the pad wheel-cases, the latter may have se rate floors of their own, and be rais

little above the floor of the water-trunk as represented in the sectional elevation, fig. 6, which will allow of a number of additional holes for the admission of water being made in the bottom of the trunk.

Fig. 5a.

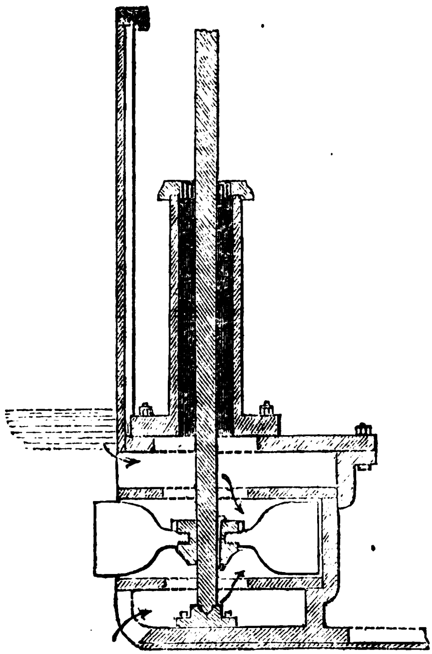


Fig. 7.

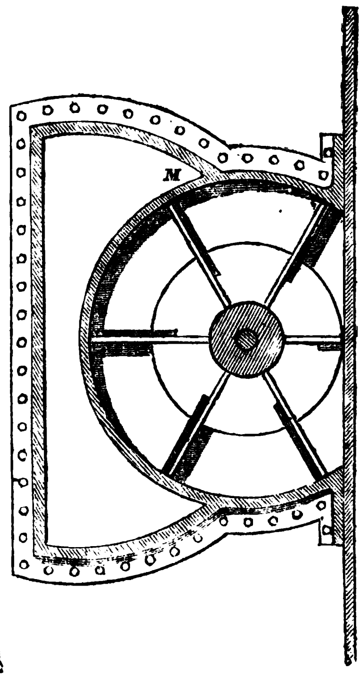


Fig. 6.

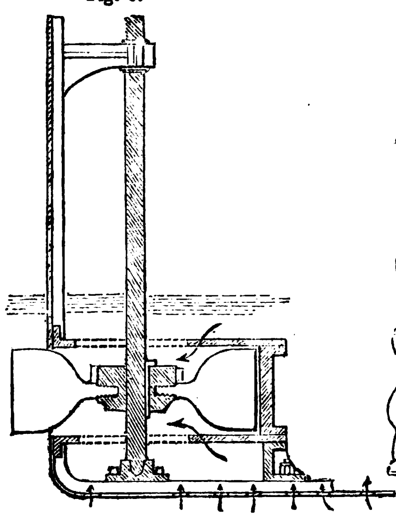
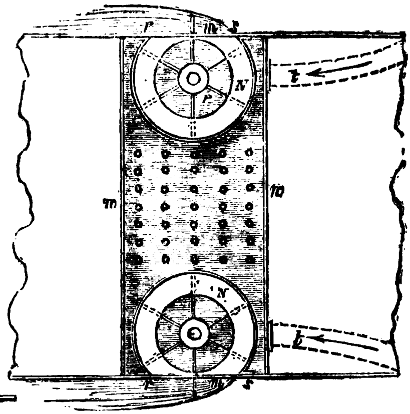


Fig. 4.



A third arrangement, much on the same principle as the last, is shown in

fig. 7. Each paddle-wheel case has a separate water-trunk, M, which is quite open at bottom to the water, and it is also itself open at bottom, as well as at top, to the water.

Should the supply of water to the interior of the paddle-wheel cases, provided for by any of the preceding arrangements, not prove sufficient, pipes may be laid from the outside of the vessel to the openings in the tops of the paddle-wheel cases, as indicated by the dotted lines *t t*, in fig. 4, which would furnish any additional supply which might be required.

Instead of the paddle-wheels being fixed horizontally under the water-line, as in the arrangements before described, it is stated that they may be fixed vertically as represented in the transverse section, figure 8, and worked by crank connections, as usual; but this plan is said not to be considered of equal efficiency with either of the two first described. H and G are channels, which would, in this modification of the invention, be necessary to admit water into the centre of the wheel for the purpose before explained. Or the paddle-wheels, when worked vertically, may be enclosed in chambers open at the top to the atmosphere, and rising above the level of the water on the outside of the vessel; in which case the water may be left to flow freely into the wheels through any number of tubes found requisite to supply the quantity ejected by them when in motion.

In all cases where the paddle-cases are not worked in chambers having an open communication with the atmosphere, it will be necessary to have air-tubes communicating between the paddle-wheel cases, C C, and the external atmosphere.

WALKER'S HYDRAULIC ELEVATOR FOR IRRIGATING, DRAINING, &c. BY MR. BADDELEY.

Sir,—I have much pleasure in redeeming a promise made to your readers some time since, respecting Mr. Walker's patent hydraulic elevator. I should have been most happy to supply this information ere this, but a prophet is not without honour, except in his own country, &c., and while Mr. Walker has been fully employed in executing *foreign* orders, it is only lately that any of these machines have been made for *home* service. Had I reported the extraordinary performances of the hydraulic elevator in foreign parts, my representations would most likely have been met with the ordinary remark of the incredulous, "We may as well believe it as go to see!" In many of the colonies and elsewhere, Mr. Walker's elevator has long been at work both for short and long lifts, and its performances have been so transcendantly superior to anything of the kind heretofore employed, that orders for a further supply of the machines have kept the ingenious inventor pretty fully occupied, and left him little time to push their introduction in England. I have already apprised your readers of the successful working of one of the elevators put up in Woolwich Dockyard, about fifteen months since, and worked by manual power, (vide vol. xli. p. 373.) This machine continues to perform its duty to the entire satisfaction of the authorities, and to the astonishment of all who see it, leaving everything else of the pump kind immeasurably behind.

Within the last few months two machines of much greater power have been erected in this country. The first of these has been put up by Mr. Walker for Mr. Merryweather, of Lincoln; it has two working barrels, 18 inches in diameter, with a stroke of 9 inches each. The lift is about 9 feet, and the machine is set in motion by a steam-engine of three horses power; at a speed of 60 revolutions the delivery is 2,000 gallons per minute! The second machine is of still greater power, and has been erected for the Commissioners for Draining the county of Somersetshire; it has two barrels, each 24 inches in diameter, with 18 inches stroke, with an average lift of 7 feet, (the minimum being 5, the maximum 9 feet.) The steam-engine is of six horses power, and when making 30 revolutions per minute the speed of the elevators is 45, and the water delivered 4,500 gallons! The engine is capable of driving the elevators at a speed of 80 revolutions per minute, the delivery being upwards of 8,000 gallons. It was satisfactorily proved by the Commissioners, that when working at the rate of 50 revolutions, 5,000 gallons were delivered; and although the drain was 8 feet wide and 2 feet deep, the water running 50 feet per minute, it could not keep the elevators supplied at this speed. The speed of 45 was maintained for se-

veral consecutive days, the engine working at little more than half its power, and the consumption of fuel proportionably small. Near where the elevator has been put up in Somersetshire, there is a scoop wheel driven by a 13 horses steam-engine, which can only be employed with advantage when the water is at a certain height, and under the most favourable circumstances has not delivered more than 2,000 gallons per minute, the consumption of fuel being enormous. Similar wheels are much used in Lincolnshire; and Mr. Merryweather states that, with Mr. Walker's hydraulic elevator, his three horses engine will raise more water than his neighbours can accomplish with their 8 horses engines driving the wheels. Each of the foregoing elevators is fitted with Mr. Walker's patent gridiron valves.

For draining or irrigating on low lifts, where *quantity* is the object, Mr. Walker's elevators can be made to deliver almost any required quantity by means of considerably less power (fuel) than any other machine. The engine and elevator fixed in Somersetshire are very simple, and so arranged that one of the farm servants can manage it with perfect safety. There is no leather, or other material subject to rapid wear, and the expense for repairs must of necessity be very trifling. For deep lifts and mines similar advantages will attend the introduction of the elevator; and much as we now think of the performances of the Cornish pumping-engines, the day is probably not very far distant when their present high rate of duty will be greatly increased.

On comparing the performances of Mr. Walker's elevators with the usual standard of a horse power, (33,000 lbs. lifted 1 foot high in a minute,) their value and importance will become apparent. It will be found also, on calculation, that the quantity of water delivered *greatly exceeds the cubical contents of the barrels*,—a most material element of their success. Mr. Walker's secret—if secret, indeed, there be—consists in the direct and useful application of all the momentum resulting from the communication of motion to matter. In ordinary pumping-engines a powerful impulse is created in one direction, destroyed, and then renewed in a different direction; thereby involving an enormous loss of power, and entailing the most injurious effects upon all parts of the machinery employed. In Mr. Walker's elevator there is continuous motion *in one direction*, no alternating movement; the momentum imparted to the water carries it onward in its course until it is delivered, producing the results which I have stated, and which can be confirmed most fully in every particular; but yet, I apprehend, they must be seen to be believed.

I remain, Sir,
Yours very respectfully,
WM. BADDELEY.

29, Alfred-street, Islington,
December 9th, 1845.

P.S.—I will endeavour to dispose of "A Fireman" in my next. The following errata occurs in my last:—Page 410, second column, line 14, from the top, for "*save*" read "*serve*." Same column, line 3, from the bottom, for "*places*" read "*phases*."

ON BREWING. BY HENRY DIRCKS, ESQ.

The remote antiquity of the art of brewing being unquestionable, it is rather the more surprising that in our day the practice of it should not be universally understood and as extensively practised. A desire to brew for themselves is a very prevalent feeling throughout the community, and yet no means have hitherto been devised by which this laudablewish of the public can be readily and economically accomplished. Either some peculiar apparatus is required, or that apparatus when obtained will not do for very small quantities of malt; and either way the work on this small scale is a full day's labour, just the same as if a larger quantity were brewed. Any process which is tedious, occupies many hands, requires numerous vessels, and entails the necessity of constantly seasoning tubs, &c., which in family brewing are probably only used two or three times a-year, is not likely to have many followers, however anxious they may feel to possess *home-brewed beer*. Mr. Cobbett made many efforts to introduce brewing on a small scale for farmers, but the difficulties of properly brewing from very small quantities of malt seemed insurmountable. Mr. Needham patented a very complete and compact apparatus

for the same object; but there is a great obstacle to these improvements when some peculiarly constructed and expensive kind of apparatus has to be adopted.

It is perhaps not a little remarkable that an ancient well-known art, like that of brewing, should have been less the subject of any great improvement than almost any other; many favourable changes have certainly taken place, but the art itself, as a whole, remains much about where it was a century back. The only advantage the modern brewer possesses is that of having better materials, improved apparatus, and enlarged facilities for speedy and cheap brewing. The practice of no other art requires equal acquirements and occupations. A great brewer is an agriculturist, a maltster, coal-merchant, cooper, and an extensive shipper of ale, and proprietor of public-houses. In his brewery he has to grind malt, mash it, boil the wort so obtained with hops, then cool, ferment, and barrel the beer so brewed. His malting and brewing require the utmost skill, and demand an intimate acquaintance with chemical science. It is no wonder then that brewing on the largest scale should, as up to the present time conducted, sink an immense fortune to work this ponderous machinery. This arises from a want of a division of labour which, in regard to brewing, seems never hitherto to have been contemplated. As well, for example, might a cotton-spinner, on the same principle, attempt to be a planter, a merchant, railway carrier, machine maker, and shop proprietor.

Nothing can be better calculated than the multifarious character of the operation constituting a modern brewery, to throw a veil of mystery over this needful art; hence it has been very truthfully observed, that "the press has hitherto furnished very little information on the subject of brewing."* Dr. Shannon, (who produced an excellent treatise, to elucidate the matter, in a quarto volume, occupying 307 pages, published in 1804,) pleasantly enough says in his introductory remarks,—"Although nothing, perhaps, is so *generally known*, and so *little understood*, as the process of brewing beer or ale, yet at every inn, not immediately in the vicinity of London, you may find an ostler, or an old woman, whose province it is to brew strong beer, or fine ale, for home consumption; and the same thing occurs in almost every gentleman's family in the country. In short, every cookery book gives you a receipt for brewing one sort or other of malt liquor."—p. 8.

He is not very complimentary to the *private brewer*, and by inference, we are thence led to suppose he had not in view the improvement of *his* practice, through a perusal of his large treatise on the art; for he says, speaking of the important introduction of the thermometer and hydrometer, that this standard—"at once raises the *common* out of the reach of the *private brewer*, who was, until then, as deficient in the *science of brewing*, as the other (the private brewer) has always been in the practice."—p. 236.

Not only, however, are country gentlemen, farmers, and all who may feel desirous of practising domestic brewing, whether from choice or necessity, incapable of doing this with that perfection, the want of which Dr. Shannon affects to ridicule, but even brewers themselves learn the mystery of their art always with difficulty, perhaps never to a certainty, mostly at great expense, and not unfrequently to their severe cost. If brewing did not comprehend malting, preparing of worts, and fermenting, neither the public nor common brewers would have much difficulty to contend with, whether they brewed nine gallons or 9,000 gallons. It may not perhaps be generally known that there are professors of the art of brewing, who undertake to instruct not only the amateur, but the practised brewer, and in many instances very large sums are paid to them for the communication of so-called "secrets," which are made in writing, generally under a bond of secrecy. Some of these professors have published, but their works are mostly printed for the author and vended by himself only One instance may suffice of the characte of the efforts made to enlighten the *pub lic* on the subject of brewing, and like wise of the remuneration paid by th brewer to his teacher. On referring t the article on "Brewing," p. 33, in th Library of U.K., it will be found tha Mr. Richardson's work on brewing i characterised as containing "many use ful *theoretical hints*; but it was not h

* Art of Brewing, p. 32, Lib. of U. Knowledge.

intention *to publish practical* rules." His instructions are given in the same article, the writer observing—"we shall copy them, without alteration, from a manuscript for which he (Mr. R.) was paid *a hundred and fifty guineas*, besides receiving a guarantee of *secrecy for twenty years!*" This not being a solitary circumstance of the kind, and only quoted as an illustration, from an unquestionable authority, and one that can easily be referred to, will readily account for the paucity of information to be obtained from these works, it being in general a rule that in proportion as the title page assures us of the credibility of the author, in regard to his acquaintance with the whole art and mystery of brewing, just in an inverse ratio will be the merit of his work for any communications of real utility.

Mr. Richardson, in his "Philosophical Principles of the Science of Brewing," intimates that the business of brewing was considered by every one of such easy accomplishment, that its very commonness had brought it into *contempt*, and that, therefore, it is no wonder it has "so generally escaped a liberal investigation, when the pretension to a competent knowledge of it, in every person who keeps a common victualling-house, and in almost every servant girl who engages to do the drudgery of a farmer's kitchen, has rendered an art of the first national importance, an object of the veriest insignificance, and not seldom of ridicule and contempt, considered as a scientific subject!" This convincing line of argument he further pursues, by observing—"Hence it is that *brewing of malt liquors*,—an art more complicated in its processes, and more delicate in the criterions which mark the several stages of its various operations than perhaps that of producing any other domestic liquor in the world,—is generally entrusted to the care and superintendence of persons wholly ignorant and illiterate, to the great detriment of both the produce and the employer." This reproachful dabbling of the public with an art which should concern them only as regards its produce, and not its mysteries, is set forth by Mr. Richardson in language too striking to be mistaken. "In the country (he informs us) this is almost universally the case, the acting brewer being no other than one of the common servants of the office, preferred to this charge on the sole consideration of his having been employed in a brew-house somewhat longer than his fellows; whence arise those disagreeable qualities so often complained of in the beer of many common brew-houses, to the discredit of the practitioner, and the disgrace of the profession, whilst *home-brewed beer* is extolled and preferred, in terms equally reproachful and injurious to both." If such treatises as these are written, as they ought to be, to explain the theory, and simplify the practice of brewing, such complaints as are here set forth are entirely out of place; as well might the village blacksmith be instanced, to prove that by his rude work he brings discredit on the iron trade in all or any of its branches. The absurdity of such statements is glaring; we cannot understand on what principle, other than a very selfish one, the public are to be broadly informed they have no right to attempt private brewing, and that their notion of their *home-brewed beer* being of such first-rate quality, as they imagine, is a serious delusion, for that such ale has only been brewed by perhaps a "servant girl, who engages to do the drudgery of the farmer's kitchen," or "persons wholly ignorant and illiterate," such as one who has only been "employed in a brew-house somewhat longer than his fellows," or "one who keeps a common victualling-house," and like barbarously ignorant pretenders to a profession far above the stretch of their limited intellects to comprehend, and of which their humble station in society must ever keep them out of the pale of improvement, especially as they have been guilty of the heinous offence of producing *home-brewed beer* which a simple public has perversely, from time to time, "extolled and preferred, in terms reproachful and injurious" to the common brewer and the profession.

Brewing in all its departments is truly chemical, and by that science alone can it be advantaged, some few manipulations excepted; it may, therefore, be fearlessly stated, that a pretence to scientific secrets is derogatory to the character of a philosophical enquirer; and there being nothing in the art which is not clearer to the chemist than the uninformed, the pretender to the possession

of secrets deserves only to be stigmatized as a quack.

Improvements, tending, by the introduction of a division of labour into the art of brewing, to simplify that, at present, abstruse process, and render it as competent for the cottager as the more wealthy to brew their own beer, was not contemplated at the time of the publication, in 1829, of the treatise issued by the Society of K. U., otherwise the article in question would not conclude by so eulogising the saccharometer, as confidently to state, that in default of it—"no brewing, whether great or small, can be conducted with advantage;"—adding, "with the degree of knowledge which we now possess, the expectation of being able to brew good malt liquor, without knowing the strength of the worts, seems almost as absurd as to attempt the process, without either weighing the hops or measuring the malt!" yet this apparent *absurdity* is overcome, and thus is another illustration afforded of the short-sightedness of our most acute attempts to anticipate the march of improvement, or find in any human invention the *ne plus ultra.*

Brewing, which, as hitherto conducted, has been a considerable monopoly, cannot much longer retain its position. The public, supplied with the pure "Extract of Malt and Hops,"* may brew for themselves with many remunerative advantages. The process of brewing may be got over in half-an-hour, that is, preparing the wort and getting it, mixed with the yeast, into a 9, 18, or 36 gallon barrel. The fermentation, though a process requiring management and attention, is easily learnt; and once begun, it goes on regularly, if the temperature is attended to, without further trouble for two or more days, as may be required. By this mode of brewing, a family may brew as large or as small a quantity of beer as they please; and, contrary to the old system, they are not *obliged* for *economy's* sake to brew *any table beer;* the choice is quite their own to brew all particularly strong, or all light ale; and what is more, this is the first improvement that will put it into the power of the public to produce an article yet unheard of—*home-brewed porter.*

* The extract referred to is that recently patented by Mr. Dircks.

THE COAST LIGHTS OF GREAT BRITAIN AND IRELAND.

[From Report of the Select Committee of the House of Commons on Lighthouses.]

Your Committee has the satisfaction of reporting, that, "according to the evidence before them, the public general lights on the coasts of England, under the management of the Trinity House in London; those on the coasts of Scotland, under the management of the Northern Commissioners in Edinburgh; and the lights on the coast of Ireland, under the management of the Ballast Board in Dublin, are all maintained in an efficient state."

The complaints made in petitions to the House of Commons, and by witnesses before your Committee, have not been in any case against the efficiency of the lights, but against the high charge for light dues, or the mode of levying them, or the irregularity of the rates.

Amongst the witnesses, Captain Moore, who has been for 23 years in the trade between the United States of America and England, states that he considers the English lights, on the whole, better than those of the United States. Captain Washington, R.N., on the Surveying Department on the coast, says that, "generally speaking, the lights, light-vessels, buoys, and beacons, are efficient, the lights brilliant, and the lighthouses clean and in high order." Captain Denham, R.N., also a Marine Surveyor, and long employed on the coasts, bears the same testimony to the efficiency of the lights of the United Kingdom.

On the 19th of February, 1844, the Secretary to the Trinity House of London, in a letter to the Secretary of the Ballast Board of Dublin, "expresses the great satisfaction with which the Trinity House had received the Report of their Visiting Committee, of the efficient state of the lighting apparatus throughout Ireland." And on the 21st February, 1844, the Secretary to the Trinity House, in a letter to the Secretary of the Commissioners of Northern Lights, states:

"I have it in command to request you will express to the Commissioners the satisfaction of the Elder Brethren at being enabled to communicate that the lamps and entire lighting apparatus were found to be in perfect and efficient order throughout the lighthouses in that part *of the United Kingdom.*"

Public, General, and Harbour or Local Lights.

The lights have hitherto been divided into two classes; viz., the public general lights, which are of use to all vessels passing the coasts; and the harbour or local lights,

which are specially for the use of vessels resorting to particular ports.

The first class is now under the Trinity House in England, the Northern Commissioners in Scotland, and the Ballast Board in Ireland.

The harbour lights in England and Scotland are managed, under power given by the Legislature, or emanating from other authorities, by Corporations and local Trustees, such as the Corporation of the Trinity House of Newcastle-upon-Tyne; the Corporation or Dock Company at Liverpool; the Seamen's Fraternity at Dundee; and many others—all of whom collect the requisite dues for their support: but the Trinity House of Deptford Strond, by the Act of 1836, have a general superintendence over all such harbour lights, and are consulted, if necessary, respecting the alteration of old, or the erection of new lights; and also as regards the alteration of, or the laying down of new buoys.

The Deputy Master states, "that every place that wants to put up a local light applies to the Trinity House for their sanction, and they give directions for the sort of light, whether it should be a red light or a white light, so that it should not interfere with the general coast lights."

In Ireland, the Ballast Board has charge and management of all the harbour as well as the public lights in that kingdom, except one at Belfast; and they receive dues from vessels entering the several harbours, and pay the expenses of maintenance, in the same manner as they take charge of and maintain the public general lights.

Comparison of Number of Lights in 1834 *and* 1844.

In England, in 1834, there were 126 lights, viz.:—			
Belonging to the Trinity House	42 fixed	13 floating	
Under their management	1 ,,	1 ,,	
In private hands:—			
On lease from the Trinity House	3 ,,		
Ditto from the Crown	7 ,,		
By Patent and Act of Parliament	4 ,,		
Local or harbour lights	51 ,,	4 ,,	
Totals	108 ,,	18 ,,	126 total.
In 1844 there were—			
Of public general lights under the Trinity House	65 fixed	25 floating	
Breakwater, Plymouth		1 ,,	
Total number of lights	65 ,,	26 ,,	91 total.
Of harbour or local lights	75 ,,	9 ,,	84 ,,
Total number of lights			175 ,,

Of these, there were in 1844—50 public general lighthouses, having	674 burners.
11 Dioptric of first order, equal to 14 burners each	154 ,,
4 Ditto of second order, equal to 9 burners	36 ,,
25 Floating	288 ,,
Total number of burners	1,152 ,,

In 1834 there were in Scotland 53 lights of which 25 were public general, under the Commissioners of Northern Lights, and 28 local or harbour lights under local authorities.

In 1844 there were, in *Scotland*, 25 lighthouse stations, of which four were double, viz., Isle of May, Pentland Skerries, Pladda, and Girdleness. And, at the request of the Post-office, the Commissioners have taken charge of the harbour light at Port Patrick. There are now 29 public general lights, under the direction of the Commissioners; of these public general lights 14 are Catoptric fixed lights; 9 are Catoptric revolving lights; 3 are Dioptric revolving lights; and 3 Catoptric intermitting lights. Since 1833 the number has increased from 25 to 29. There are 3 new lighthouses in the course of preparation; viz., one at the entrance of the Cromarty Frith, one at the entrance of Beauly Loch, opposite Fort George, and one on the Headland opposite Cove Sea Skerries, on the coast of Elgin: all of these will be lighted in the course of the present year.

There are now 4 Dioptric and 21 Catoptric lights, viz.:—

In 21 lights, Argand burners....	424
„ 4 „ Dioptric burners estimated at 17 Argands each ..	68
Total number of burners....	492

There are also 38 local or harbour lights, being an increase of 10 since 1834, all under separate Commissioners or local authorities, besides others in the fishing season.

In *Ireland*, in 1834, there were 23 fixed public general coast lights, three floating lights, and nine harbour lights, all under the charge of, and maintained by the Commissioners of the Ballast Board, and five other harbour lights supported by local authorities; making the whole number of 40 lights of all kinds at that time.

In 1844, there were 27 public general coast lighthouses, and three floating lights; and also 29 local or harbour lights; making the number 60 at that time, and showing an increase of 20 since 1833.

The number of burners in the 27 public general coast lights were	583
Ditto in the 29 harbour lights ..	216
Total number of burners....	799

The aggregate number of lights in the *United Kingdom* in 1833-34, was 219, consisting of 105 public general coast lights, of 93 local or harbour, and 21 floating lights, viz.:—

	Public General.	Floating Lights.	Local or Harbour.	Totals.
In England............	57	18	51	126
In Scotland	25	—	28	53
In Ireland	23	3	14	40
Total	105	21	93	219

The aggregate number of lights in the United Kingdom in 1844 was 309, consisting of 121 Public General Coast Lights, of 29 Floating Lights, and of 159 Local or Harbour Lights, for the positions of which the map of the Trinity House may be referred to.

	Fixed Coast Public.	Public Floating Vessels.	Local Harbour.	Total.
In England	65	26	84 Including 8 Floating Lights.	175
In Scotland..........	29	—	38	67
In Ireland	27	3	30 Including Belfast.	60
In the Isle of Man	—	—	7	7
Total	121	29	129	309

There has consequently been an increase in the United Kingdom of 83 lights since 1833, consisting of 16 of public general, of 8 floating, and of 59 local or harbour lights, viz.:—

In England of 8 public general, of 8 public floating, and of 33 harbour lights: total..................	49
In Scotland of 4 public general, and of 10 harbour lights............	14
In Ireland of 4 public general, and of 16 harbour lights..............	20
Total	83

Note.—The Isle of Man lights were not returned in 1833, but are now included in the total number, and will make..................

The total gross receipts for the p[illegible]lic general lights in the year 1832, by the Trinity House, Commissioners of Nort[illegible] Lights, private individuals, and the B[illegible] Board, were.................. £24[illegible]04

The total gross receipts of dues for the public general lights in 1843,—were

By the Trinity House ..	£257,776	
By the Commissioners of Northern Lights	43,840	
By the Ballast Board ..	55,289	
		356,905

Showing an aggregate increase of light dues of................£116,601 in 1843, as compared with 1832.

That large aggregate increase in the public light dues has been in two kingdoms as follows: on average of three years ending 1st January, 1844, compared with three years ending January, 1834.

In England the increase has been very large, but no comparison can be made between these periods, as the private lights have been purchased since 1834.

In Scotland the increase has been..		£24,360
In Ireland	ditto	26,763
Total		£51,123

It must be evident that so large an amount levied on the commercial shipping for the public general lights, besides the amount levied for local or harbour lights, must form a considerable portion of their expenses.

Returns from some of the harbours of the amount of local light dues will be found in the Appendix, but there has been difficulty in obtaining returns, and no correct account has been made up of the total amount of these dues in the harbours.

It may be observed, that in the lists of lights, general and local, published officially from the Hydrographer's-office, and made up to 1844, there are only 238 lights of various kinds.

ECONOMY IN THE MAINTENANCE OF LIGHTHOUSES.

For many years the French have used for their lights colza or rapeseed oil, which costs about 3*s*. 8*d*. a gallon, whilst in England the best sperm oil is used, which costs from 5*s*. to 8*s*. per gallon; the price of oil alone must make a considerable difference in the expense of maintenance. Mr. Wilkins, of Long Acre, a Lighthouse Lamp Manufacturer, has invented a lamp of peculiar construction, in which he burns rapeseed oil; and he has offered to supply and maintain a lighthouse of 15 burners, providing lamps, oil, and everything necessary to maintain the light, exclusive of wages and furniture for the lighthouse, at the rate of 151*l*. 9*s*. for twelve months. He says that half the expense of the oil for lights would be saved by using the rapeseed oil. But Mr. Halpin (of the Ballast Board, Dublin,) states that about one-sixth more of rapeseed oil than sperm oil is consumed in the same time, and that in his opinion the saving will not be so much. Mr. Wilkins states, in proof of his opinion, that he has, for some years past, supplied rapeseed oil to several lights abroad, the light at Dover, the Tees navigation lights, the light at the Nore, and at other places, where the rapeseed oil has given a brilliant light, and is spoken of confidently as likely to afford a great saving.

Your Committee consider, that after such experience, the public lights in this country may safely be tried with that oil, with the view of economy. By reference to the Appendix for an example, it appears that the whole ordinary expense of the Flamborough light was 701*l*, in the year 1843; and of that sum 303*l*. was for oil. The Dungeness light cost 532*l*. for ordinary maintenance, and the oil cost 229*l*. of that sum. But the comparison of aggregate expense, when applied to any other charges than the mere expense of oil and lighting stores, is fallacious, because establishment of keepers and other expenses must be the same, whether the number of burners be more or less; and Mr. Herbert states that there is no certain standard of comparison applicable to any other charges there. At Pakefield, for example, one burner is kept, but the servants to attend it, viz. a principal and assistant, are as many as at Beachy Head, where there are 30 burners.

In the United States, a Committee of Congress has reported on their lighthouse establishment, and have stated that their expenditure for their 272 lights in 1842 was only 85,724*l*. Whilst the amount of 508*l*. was the average charge in 1832 for each of the land lights in the United Kingdom, the average expense in the United States was only 190*l*. sterling; but, as has been already stated, entire reliance cannot be placed on this comparison until the whole of the circumstances are more fully ascertained.

It is proper to observe, that that Committee in the United States made experiments as to the power of illumination, by lard, by sperm oil, and by gas from resin, and the result would warrant the belief that a great saving might be effected in our lighthouses by the use of lard, oil, gas from resin, or of other substitutes for sperm oil; and the result of these experiments is stated to have been,

that	3·05 burners using	lard - -	cost	32·49 cents.	And burnt for the whole night, giving the same degree of light.
	5·00 ditto - - -	resin gas	,,	88·47 ,,	
	10·00 ditto - - -	sperm oil	,,	105·95 ,,	

Your Committee would suggest similar trials to be made in this country.

Your Committee have also to state, that a calculation was made by Mr. Alan Stevenson of the average cost per burner, of the public lights in Scotland, including all the requisite stores for maintenance. Mr. Haplin, of the Ballast Board, has done the same for the lights in Ireland, and Mr. Herbert for those in England, and the following table, combining the calculations of these three gentlemen, affords a comparison of the expenses in each kingdom.

Comparative Statement respecting Lighthouses in England, Scotland, and Ireland, from Accounts and Statements laid before this Committee.

	Years.	Number of Light-houses.	Number of Burners.	Average Number of Burners per Tower.	Average Charge per Burner.			Average Charge per Lighthouse.		
					£	s.	d.	£	s.	d.
England; General Coast Lights	1843	67	864	13	31	14	6	409	0	0
Scotland - - ditto - -	1843	26	456	17½	29	13	0	516	0	0
Ireland - - ditto - -	1844	27	540	20	22	13	9	454	0	0
Ditto; Harbour Lights -	1844	29	216	7½	26	4	0	195	0	0
Total - - -		149	2,076							

Trinity House, London, 24th July, 1845. J. HERBERT, *Secretary.*

This statement is important, with a view to form some estimate of what the charge formaintaining the whole of the lights in the United Kingdom would be, if no reduction from the present prices of oil and other stores can be made.

THE STEAM PRACTICE OF THE ROYAL NAVY. COMMANDER HOSEASON IN REPLY TO "PRESSURE NOT PUFF."

Sir,—I have again read in your columns other specimens of the intelligence of your correspondent, "Pressure not Puff." I had reason to suppose, from the nature of my letter, and the severe castigation I inflicted upon him, and which he has evidently so keenly felt, that I should have induced him to attach his name, for the future, to his able lucubrations; so that I, as well as others, might know what dependence may by placed upon *his* facts. Discretion, however, it seems, he deems to be the better part of valour; and, consequently, I fear we shall never learn, with certainty, who he is. I have been highly amused with his two last letters—they are evident specimens of the wonderful ignorance a man may display, who unites a natural obtusity of intellect to the impotence of age; and thus negatives the advantages which a long life and experience are supposed to confer.

The letter I wrote has had one good end, although it has failed in bringing him out; for it has enabled me to guess with tolerable certainty, as to who he may be; and I have little doubt of the correctness of my impression, when I believe him to be the same person who, when the Parliamentary return of the performances of the several steamers of Her Majesty's navy were moved for in the year 1841, had the audacity to write a letter to the officer ordered by the Admiralty to furnish that important document, to intreat him to make a *false* report to favour his work.

The *animus* he has shown, while commenting upon my letters, as well as in reflecting upon the Board of Admiralty, will be sufficiently explained, when I state, that to their lordships directly, and to me indirectly, he is indebted for, to him, the lamentable falling off of Government contracts he receives, the Board, in their more recent distributions, having preferred "Real Pressure and no Puff." I need hardly say, that I look to him to fulfil his promise, and as there is no alteration in tone on my part, to pluck up sufficient courage to furnish me with his name.

J. C. HOSEASON,
Commander R. N.

[We have no idea to whom Captain Hoseason alludes in this letter, as being the supposed writer of the letters signed "Pressure not Puff;" but we think it right to state at once, that none of the circumstances by which he imagines he has identified the

party, can possibly have the smallest application to the real author. He never has been a Government contractor, and is as little open to the imputation of "impotence of age," as Captain Hoseason himself. We regret the manner of Captain Hoseason's present letter, but cannot deny him the opportunity of vindicating himself in his own way. Perhaps there has been but too much personality on both sides. With respect to the call made on "P. N. P," to give his real name, we may repeat what we have said (in substance) some hundreds of times before, that as long as a writer's facts and arguments do not rest on his *personal* authority, it matters nothing whether he writes in his own name, or anonymously; indeed it is better for the cause of truth, that he should adopt the latter course.—Ed. M. M.]

ON A SPECIMEN OF ARTIFICIAL ASBESTOS. BY F. PENNY, PH. D., PROFESSOR OF CHEMISTRY IN THE ANDERSONIAN UNIVERSITY.

For a specimen of this substance, I am indebted to Mr. William Murray, of Monkland; and, for a very accurate analysis of it, to his son, Mr. Francis Murray.

It was found in a Blast Furnace, imbedded in the mass of matter which had collected at the bottom of the furnace in the course of two years and a half, and which is technically called the hearth; it was in a cavity, about eight inches below the level on which the liquid metal rested, and was interspersed with distinct and beautiful crystals of titanium.

In all its general characters, this substance corresponds with asbestos. It is colourless, inodorous, and tasteless—and occurs in small masses, composed of extremely minute filaments or fibres, cohering longitudinally together. These fibres are very easily detached from each other—and are flexible, though not so much so as the common asbestos. They have a silky lustre, and are unattacked by sulphuric, nitric, or muriatic acid. They remain unchanged in the flame of a spirit lamp, and are difficultly fusible even with the blowpipe.

A preliminary examination having been made to ascertain the ingredients contained in the substance, ten grains of the longest and cleanest of the fibres were selected for analysis. This was the largest quantity that could be obtained free from adventitious matter. The process adopted was the one usually recommended for the analysis of insoluble siliceous minerals. The following are the results per cent;—

Silica	72·5
Alumina	9·0
Protoxide Manganese	13·2
Magnesia	2·0
Lime	1·58
Iron	2·65
	100·93

On comparing the above with the analyses that have been given of the several varieties of asbestos, we remark, that the artificial specimen contains about ten per cent. more silica, and that magnesia, of which there is twenty-five per cent. in natural asbestos, is replaced by the protoxide of manganese. Now, it is well known that the protoxide of manganese is isomorphous with magnesia, and hence this replacement of the one by the other, is at once explained. I apprehend the substitution of manganese for magnesia will be found much more frequent in the mineral kingdom when minerals are submitted to improved methods of analysis. The occurrence of asbestos in an iron furnace affords a beautiful proof of the igneous origin of this substance.—*Proc. Phil. Soc. of Glasgow.*

ON ARTIFICIAL ULTRAMARINE. BY JOHN STENHOUSE, PH. D.

Till within the last twelve or fifteen years the only source of this beautiful pigment was the rare mineral, *lapis lazuli*. The price of the finest ultramarine was then so high as five guineas the ounce. Since the mode of making it artificially has been discovered, however, its price has fallen to a few shillings the ounce. Artificial ultramarine is now manufactured to a very considerable extent on the Continent, but as far as I can learn, none has as yet been made in Great Britain. The chief French manufactories of ultramarine are situated in Paris; and the two largest ones in Germany are those of Meissen in Saxony, and of Nuremberg in Franconia. Three kinds of ultramarine occur in commerce, the blue, the green, and the yellow. The two first only are true ultramarines, that is, sulphur compounds; the yellow is merely chromate of baryta.

Both native and artificial ultramarine have been examined very carefully by several eminent chemists, who, however, have been unable to throw much light upon their true nature. Chemists have undoubtedly ascertained that ultramarine always consists of silica, alumina, soda, sulphur, and a little oxide of iron; but no two specimens, either of the native or artificial ultramarine, contain these ingredients in at all similar proportions. In fact the discrepancies between

the analyses are so great as to render it impossible to deduce from them any formula for the constitution of ultramarine; if indeed it does possess any definite composition. The following are a few specimens of these analyses, and others equally discordant might easily be added.

	Lapis Lazuli. *By* Clement and Desormes	*Lapis Lazuli.* *By* Varentrap.
Soda	23·2	9·09
Alumina	24·8	31·67
Silica	35·8	45·50
Sulphur	3·1	0·95
Carbonate of Lime	3·1	3·52 Lime.
		0·86 Iron.
		0·42 Chlorine.
		5·89 Sulphuric Acid.
		0·12 Water.

	Parisian Artificial Ultramarine. *By* C. G. Gmelin.	*Meissen Artificial Ultramarine.* *By* Varrentrap.
Soda and Potash	12·863	21·47
Lime	1·546	1·75 Potash.
Alumina	22·000	0·02
Silica	47·306	23·30
Sulphuric Acid	4·679	45·00
Resin, Sulphur, and Loss	12·218	3·83
		1·063 Iron.

The last chemist who has examined ultramarine is Dr. Elsner, who has published a very elaborate paper upon it in the 23rd number of *Erdmann's Journal* for 1841. The first part of Dr. Elsner's paper is historical, and contains an account of the accidental discovery of artificial ultramarine by Tassart and Kuhlman in 1814, and of the labours of subsequent chemists. He then gives a detailed account of his own experiments, which have been very numerous, and from these he deduces the following conclusions: 1st, That the presence of about one per cent. of iron is indispensable to the production of ultramarine; he supposes the iron to be in a state of sulphuret. 2nd, That the green ultramarine is first formed, and that as the heat is increased it passes by degrees into the blue. The cause of this change is, he affirms, that part of the sodium absorbs oxygen from the atmosphere, as the operation is conducted in only partially closed vessels, and combines with the silica, while the rest of the sodium passes into a higher degree of sulphurization. Green ultramarine therefore, contains simple sulphurets and blue, polysulphurets.

Dr. Elsner's paper does not, however, furnish any details by which ultramarine could be manufactured successfully on the great scale. Thus, for example, in regard to the necessary degree of heat, perhaps the most important circumstance in the process, he gives no directions whatever. We know, however, from other sources, that it should be a low red heat, as at much higher temperatures both native and artificial ultramine soon become colourless. Dr. Elsner, indeed, does not affirm that he was able to procure ultramarine in quantity of a uniformly good colour. In fact the process of Robiquet, published nearly ten years ago, is the best which scientific chemists possess, though undoubtedly, the manufacturers have greatly improved upon it. Robiquet's process consists in heating to low redness a mixture of one part porcelain clay, one and a half sulphur, and one and a half parts anhydrous carbonate of soda, either in an earthenware retort or covered crucible, so long as vapours are given off. When opened the crucible usually contains a spongy mass of a deep blue colour, containing more or less ultramarine mixed with the excess of sulphur employed, and some unaltered clay and soda. The soluble matter is removed by washing, and the ultramarine separated from the other impurities by levigation. It is to be regretted, however, that the results of Robiquet's process are by no means uniform; one time it yields a good deal of ultramarine of excellent quality, and perhaps, at the very next repetition of the process in circumstances apparently similar, very little ultramarine is obtained, and that of an inferior quality.

The fabrication of ultramarine is a subject which well deserves the attention of English chemical manufacturers, as it could be carried on with peculiar advantage in this country. The chief expense of the process is the fuel required, which can be purchased in Great Britain for less than half the money it would cost either in France or Germany.—*Proceedings of the Glasgow Philosophical Society.*

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED UNDER 6 AND 7 VIC., CAP. 65, FROM NOVEMBER 26, TO DECEMBER 22, 1845.

Date of Registration.	No. in the Register.	Proprietors' Names.	Address.	Subject of Design.
Nov. 26	589	John Dent, Wm. Dent and J. M. Allcroft...	Of Worcester, and 97, Wood-st., Cheapside, London	Stud or fastening for gloves and other articles of dress.
28	590	Callistus Augs. Godde Liancourt & Richard Childs,................	South Audley-street, Grosvenor-square .... Queen Anne-street, Cavendish-square	Parisian button.
29	591	George Stacy	Uxbridge	Improvements in chaff-cutters, whereby various lengths of hay, straw and other fodder are adjusted for cutting.
,,	592	George E. Frere and Benj. Tucker Stratton	Edinburgh.......................... Bristol	Lifting apparatus for clod crushers, scarifiers, and such like implements.
Dec. 1	593	Robert Spenceley	Ely...................................	Double-action pump.
,,	594	George Macfarlane......	41, Gerard-street, Soho, London.	Cornopean [cornet à piston) trumpet, French horn, trombone, and ophiecleid.
3	595	Joseph Rock Cowper...	24, Legge-street, Birmingham...	Percussion cap-holder.
5	596	John Finning	25, Collier-street, Pentonville....	Instrument for describing curves.
,,	597	Galt and Son...............	High-street, Portsmouth	Wire-frame washing stand.
8	598	R. Garrett and Son.......	Leiston Works, Saxmundham, Suffolk.	Improved barley aveler, or hummelling machine.
9	599	John Hawkins,...........	Green-lane, Wallsall................	Improved bit.
,,	600	Thomas Varty............	York House, Strand. ...,............	Serial-tablet frame.
10	601	Stephen Martin..........	Leven, near Beverley, York......	Improved horseshoe.
,,	602	James Lancaster........	Birmingham	Spectacle frame.
11	603	Tyler and Pace...........	Cornhill, and Hackney............	Perforated-metal shade.
15	604	Charles Fred. Darwall.	Wallsall	Cornubella.
16	605	James Chesterman...... and John Bottom......	Ecclesall, New-road St. Phillip's-road.... Sheffield...	Case for tape measures.
,,	606	Wm. Godfrey Robinson	13, Stuckley-terrace, Hampstead-road................................	Vertical meter.
17	607	B. H. Bullock............	2, Chester-street, Grosvenor-place..................................	Distance measurer for maps, charts, &c.
18	608	John Keyse	27, Crosby-row, Walworth-road..	Improved swimming apparatus
19	609	Draper and Hooker.....	Basingstoke..........................	Improved carriage.
20	610	Richard Millard	Craven-street, Strand..............	Portable recumbent and easy chair.
,,	611	Wm. Godfrey Robinson	13, Stuckley-terrace, Hampstead-road..................................	Vertiaximmeter, certain additions to the prismatic compass for the purpose of combining with that instrument the principle of the vertical-meter, by which vertical angles are approximately measured without the aid of a stand, or artificial horizon.
22	612	Boyd and Harmer......	Spital-square	Vapour bath.

LIST OF ENGLISH PATENTS GRANTED BETWEEN NOVEMBER 27, AND DECEMBER 24, 1845.

John White, of Salford, Lancaster, engineer for certain improvements in engines, machinery or apparatus for raising and forcing water. November 27; six months.

Peter Spence, of Burgh, Cumberland, for improvements in the manufacture of copperas and alum. November 27; six months.

Moses Poole, of Serle-street, Middlesex, gent., for certain improvements to hinder the oxydation of iron in all its various states of cast metal, steel, malleable iron, and also to render malleable iron more hard and durable. (Being a communication.) November 27; six months.

Eden Thomas Jones, of Bristol, manufacturing chemist, for improvements in the apparatus used in the concentration of sulphuric acid. November 27; six months.

William Maugham, of Newport-street, Surrey, consulting chemist, and Archibald Dunlop, the younger, of Upper Thames-street, gent., for improvements in the manufacture of ale, porter, and other fermented liquors. November 27; six months

Edward Dell, of Woolwich, wine merchant, for certain improvements in apparatus for heating and warming. December 4; six months.

Robert Rettie, civil engineer, of Glasgow, for an improved method of signalizing, or telegraphing on sea or land, preventing collision at sea, and giving signals of distress by improved burners with glasses coloured, and signal cards, applicable to railways in all the various departments, as well as preventing of accidents when the train is at full speed, showing the state of the tide in harbours, also the diurnal for railways, towns, villages, &c. December 4; six months.

William Gossage, of Neath, metallurgist, for improvements in obtaining products from certain ores and other compounds of certain metals. December 4; six months.

John Leslie, of Conduit-street, Hanover-square, tailor, for improvements in the combustion of gas. December 4; six months.

Moses Poole, of Serle-street, Middlesex, gent., for improvements in locks. (Being a communication.) December 4; six months.

James Meacock, of Kingston, Jamaica, merchant

for improvements in pulping, dressing and sorting coffee. December 4: six months.

Archibald Dunlop, jun., of Thames-street, London, gent., for improvements in the manufacture of aerated waters. December 4; six months.

Henry Bessemer, of Baxter House, Old Saint Pancras-road, Middlesex, engineer, for certain improvements in atmospheric propulsion, and in apparatus connected therewith, part, or parts of which improvements are applicable to the manufacture of columns, pipes and tubes, and other parts are applicable to the exhausting and impelling of air and other fluids generally. December 5; six months.

John Robert Johnson, Alfred-place, Blackfriars, chemist, for improvements in the materials employed in constructing and working atmospheric railways. December 6; six months.

Henry Heathcote Russell, of Millbank-street, Westminster, civil engineer, for improvements in constructing suspension bridges and viaducts. December 6; six months.

Josiah Wilkinson, of Lincoln's-inn-fields, gent., for certain improvements in filtering water and other fluids. (Being a communication.) December 8; six months.

Henry Augustus Box, of Great Titchfield-street, St. Marylebone, decorator, for a new method of polishing, dyeing, and colouring marble, stone, and certain other materials used in the construction or decoration of houses and other buildings. December 10; six months.

Edward Green, of Wakefield, York, engineer, for a new method of economizing fuel and certain improvements in retaining and applying heat for generating steam and heating water. December 10; six months.

Thomas Williams, of Norway-street, Middlesex, gentleman, for a certain improvement or improvements in wrenches or spanners. December 10; six months.

William Dines, of Oldston, near Dartmouth, Devon, Esq., for improvements in the making and fixing window glass. December 10; six months.

George Mordey Mowbray, of Paternoster-row, London, wholesale druggist, for an improved method of communication between the person or persons having the charge of a railway train and the controller of its motive power. December 10; six months.

Robert William Thomson, of Adam-street, Adelphi, civil engineer, for an improvement in carriage wheels, which is also applicable to other rolling bodies. December 10; six months.

Henry Lawrence, of Wigmore-street, Cavendish-square, gentleman, for an improved buckle, suitable for harness and other purposes. December 10; six months.

George Leach Ashworth, of Rochdale, Lancaster, cotton spinner, and Wilson Crossley, of the same place, manager, for certain improvements in machinery or apparatus for preparing and spinning cotton and other fibrous substances. December 10; six months.

James Garforth, of Dunkinfield, Chester, engineer, for certain improvements in machinery or apparatus for connecting of boilers, and other purposes. December 10; six months.

Alfred Vincent Newton, of Chancery-lane, mechanical draughtsman, for improvement in printing and dyeing various fabrics. (Being a communication.) December 10; six months.

Christopher Dunkin Hays, of Bermondsey, master mariner, for improvements in the construction and adaptation of apparatus for propelling and steering vessels on water. December 10; six months.

Charles Dowes, of Camden-town, gentleman, for an improved paper or material. December 10; six months.

William Mushet and Robert Mushet, iron founders, of Dalkeith, Scotland, for improvements in moulding iron. December 10; six months.

Thomas Victor Allier, of Quai Saint Michel, Paris, gentleman, for improvements in breaks or machinery for stopping or retarding carriages. December 10; six months.

Frederick Gye, jun., of South Lambeth, for improvements in preparing aerated waters, and in vessels to contain aerated and mineral waters. December 10; six months.

Moses Poole, of Serle-street, Middlesex, gentleman, for improvements in apparatus to be used for drawing and marking. (Being a communication.) December 10; six months.

William Mac Naught, of Robertson-street, Glasgow, engineer, for certain improvements in the steam engine. December 10; six months.

Isaac Hawker Bedford, of Birmingham, for improvements in the manufacture of window and other glass. (Being a communication.) December 12; six months.

Moses Poole, of Serle-street, Middlesex, gent., for improvements in filling bottles and other vessels, and also in covering, stopping, or securing liquids and other matters in bottles and other vessels. (Being a communication.) December 12; six months.

Samuel Cunliffe Lister, of Manningham, York, gent., for improvements in carding, combing and spinning wool. December 12; six months.

Thomas Findler, of Flint, miller, for improvements in the construction and operation of certain parts of flint-grinding mills, and other grinding mills or machinery for grinding. December 15; six months.

John Robert Johnson, of Nelson-square, chemist, for improvements in purifying gas, and in the treatment of products of gas works. December 20; six months.

Henry Mandeville Meade, of New York, America, gent., for certain improvements in the manufacture of bread. (Being a communication.) December 20; six months.

George Fergusson Wilson, of Belmont, Vauxhall, gent., George Gwynne, of Regent-street, gent., and James Pillans Wilson, of Belmont, aforesaid, gent., for improvements in treating certain inflammable matters, and in the manufacture of candles. December 20: six months.

William Hannis Taylor, of Piccadilly, gent., and Francis Roubilliac Conder, of Birmingham, civil engineer, for certain improvements in propelling. December 20; six months.

Jabez Church, of Colchester, gas engineer, for improvements in the manufacture of coke, and in the ovens for producing the same. December 20; six months.

John Blyth, of Limehouse, engineer, for certain improvements in diminishing the risk of accidental explosions of gunpowder and other substances which are liable to explode, or ignite by contact with fire. December 20; six months.

William M'Hardy, of Salford, for certain improvements in machinery or apparatus applicable to the preparation and spinning of cotton, wool, silk, flax, and other fibrous substances. December 22; six months.

Alfred Vincent Newton, of Chancery-lane, draughtsman, for improvements in combing wool. (Being a communication.) December 22; six months.

Samuel Heseltine, junr., of Bromley, Middlesex, civil engineer, for improvements in machinery or apparatus for dressing stones for grinding corn, grain, and other substances. (Being a communication.) December 22; six months.

Philip Smith, of High-street, Lambeth, locksmith, for improvements in locks, latches, and other similar fastenings. December 22; six months.

LONDON: Printed and Published by James Bounsall, at the Mechanics' Magazine Office, No. 166, Fleet-street.—Sold by A. and W. Galignani, Rue Vivienne, Paris; Machin and Co., Dublin; and W. C. Campbell and Co., Hamburgh.

INDEX

TO THE FORTY-THIRD VOLUME.

ALPHABETICAL LIST OF NEW PATENTS GRANTED FOR ENGLAND, SCOTLAND, AND IRELAND.

Name.	Subject.	England.	Scotland.	Ireland.	Page.
Abbe	Apparatus for spinal disorders	4 Aug.	....	....	159
Ackerman	Harpoon	3 Nov.	9 Oct.	....	304—382
Addison	Pianofortes	....	22 Jun.	....	112
Albert	Soap	28 Jun.	2 Oct.	....	62—304
Allier	Breaks	10 Dec.	....	....	448
Amesbury	Removing stiffness, weakness, &c.	....	18 July	....	112
Ashworth	Cotton spinning	10 Dec.	....	....	448
Atha	Atmospheric engines	4 Nov.	....	....	382
Ayre	Sailcloth	15 Nov.	30 Oct.	....	383—384
Baggs	Motive power	26 June	29 July	....	62—160
Bain	Electric telegraph	25 Sept.	....	....	288
Bankart	Refining ores	7 Aug.	....	....	159
Barber	Graining & decorating	11 Oct.	....	....	303
Barnes&others	Dyeing and Printing Cotton, &c.	8 July	....	....	62
Barsham	Mattresses	16 Oct.	....	....	303
Beadon	Propelling vessels	29 July	....	....	159
Bedells	Weaving	29 July	....	....	159
Bedford	Glass	12 Dec.	....	....	448
Bell	Drying seeds	....	12 Aug.	....	160
Bell	Alkali	3 Nov.	19 Nov.	....	382—384
Bessemer	Atmospheric propulsion	5 Dec.	....	....	448
Betts	Brandy	16 Oct.	....	....	303
Bewley	Syringes	4 Sept.	....	....	223
Bickford	Miner's fuse	6 Nov.	....	....	383
Biddle	Windmills	3 Nov.	....	....	382
Bielefield	Embossed leather	11 Nov.	....	....	383
Binks	Nitrogen compounds	3 Nov.	....	....	382
Bishop	Mechanical power	2 Oct.	....	....	288
Blumberg	Purification of spirits	5 Nov.	....	....	382
Blyth	Gunpowder explosions	20 Dec.	....	....	448
Bossy	Waterproof paper	10 July	....	....	62
Box	Polishing marble	10 Dec.	....	....	448
Boydell	Hinges	17 Nov.	....	....	383
Boydell	Shipbuilding	17 Nov.	....	....	383
Brandling	Railway and Railway Carriages	31 Oct.	....	....	382
Brett	Propelling carriages	8 July	....	....	62
Brett	Atmospheric propulsion	21 July	19 Sept.	....	63—224
Brett	Electric telegraph	13 Nov.	27 Aug.	....	223—383
Breynton	Rotary steam-engine	25 July	12 Aug.	....	159—192
Brierly	Spinning	5 Aug.	....	....	159
Brooman	Dyeing	25 July	....	....	63
Brooman	Piece goods	10 Oct.	....	....	304
Brooman	Figure painting	3 Nov.	....	....	382
Brooman	Gas-metres	3 Nov.	....	....	382
Broughton	Grinding grain, &c.	21 July	2 Oct.	....	62—304
Brown	Embankments & propulsion	29 July	....	....	159
Brown	Drill plough	9 Aug.	....	....	159

Name.	Subject.	England.	Scotland.	Ireland.	Page.
Isoard	Motive power..........	28 Aug.	....	....	223
Ivers	Machinery for preparing wool	....	21 Aug.	....	192
James	Metal plates	25 July	....	....	63
Jamieson	Ores	10 Oct.	....	....	288
Johnston	Sugar	....	26 June	....	112
Johnson	Cotton spinning........	20 Nov.	....	....	383
Johnson	Atmospheric railways ..	6 Dec.	....	....	448
Johnson	Gas..................	20 Dec.	....	....	448
Jones	Flour	....	27 May	....	63
Jones	Sulphuric Acid	27 Nov.	....	....	447
Jonquet	Tanning	31 Oct.	....	....	382
Judson........	Rollers	9 Oct.	....	....	288
King	Electricity	4 Nov.	....	....	382
Kite..........	Chimneys	....	4 July	....	112
Knight........	Scouring.............	....	2 Oct.	....	304
Knowles	Raising coals	10 Oct.	6 Oct.	....	303
Lake..........	Propelling	9 Oct.	....	....	288
Lambaux......	Atmospheric railways ...	....	18 Sept.	....	223
Lambercan	Motive power..........	18 Sept.	....	....	223
Lambereaux....	Motive power..........	....	24 Sept.	....	304
Lampit........	Dibbling machine	4 Sept.	....	....	223
Lauring.......	Cyanides, &c. of potassium	18 Nov.	....	....	383
Laughton......	Soap	6 Nov.	....	....	383
Lawes	Propelling	....	9 June	....	63
Lawrence......	Buckle	10 Dec.	....	....	448
Leslie.........	Combustion of gas......	4 Dec.	....	....	447
Lewis	Printing	....	2 June	....	63
Liefchild	Stone blue	8 July	....	....	62
Lings..........	Preserving provisions ...	21 July	....	....	63
Lister	Carding wool..........	12 Dec.	....	....	448
Longmaid	Chlorine.............	4 Aug.	12 Nov.	....	159—384
London	Umbrellas	24 Oct.	....	....	304
Lord.........	Supplying boilers with water	....	17 Nov.	....	384
Maberley	Breaks	....	8 Aug.	....	159
Macintosh	Calico printing	....	6 Aug.	....	160
Mac Naught....	Steam engine..........	10 Dec.	....	....	448
Maire	Iron for bridges, &c.....	5 Aug.	....	....	159
Malins.........	Iron roofs	18 Nov.	....	....	383
Malcolmson....	Propelling	12 July	....	....	62
Marshall.......	Cocoa	16 Oct.	....	....	303
Mather, W. & C.	Boring earth, &c.	3 July	19 July	....	62-112 -224
Maugham.......	Ale	27 Nov.	....	....	447
Maurel........	Soap	3 July	....	....	62
Meacock	Coffee...............	4 Dec.	....	....	448
Mead..........	Bread	20 Dec.	....	....	448
Meade........	Steam engines and boilers	12 July	....	....	62
Meade	Distilling.	18 Sept.	....	....	223
Mercer and others	Dyeing and printing cotton, &c.	8 July	7 Oct.	....	62—304
M'Hardy......	Spinning cotton	22 Dec.	....	....	448
Mills and ano...	Railway springs, &c.....	3 July	....	....	62
Minland	Spinning..............	18 Sept.	23 Sept.	....	3—304
Minter........	Easy chairs	4 Nov.	....	....	22 382
Moreau........	Steam carriage	6 Oct.	....	....	288

Name.	Subject.	England.	Scotland.	Ireland.	Page.
Morewood......	Propelling	9 Oct.	....	....	288
Morgan........	Envelopes	9 Oct.	....	....	288
Moss	Bank notes............	....	29 Oct.	....	384
Mowbray......	Railway communication..	10 Dec.	....	....	448
Murray	Bricks...............	....	1 Oct.	....	304
Mushet........	Moulding iron	10 Dec.	....	....	448
Myers.......	Cutting and carving wood, &c.........	8 July	27 Aug.	....	62—223
Nalder........	Drills	28 June	....	....	62
Newton, W...	Railways and propelling carriages	3 July	....	....	62
Newton, A. V...	India rubber fabrics	28 Aug.	....	....	223
Newton, W. E..	Spinning...............	28 Aug.	8 Sept.	....	223—224
Newton, A. V...	Screw manufacture	26 Sept.	....	....	288
Newton, A. V...	Metal pipes	26 Sept.	....	....	288
Newton........	Types	17 Nov.	....	....	383
Newton, A. V...	Printing fabrics	10 Dec.	....	....	448
Newton, A. V...	Combing wool	22 Dec.	....	....	448
Newton	Nail machinery	....	20 Aug.	....	192
Nickels	Piano-fortes	27 Oct.	....	....	382
Normandy, De	Thimbles and finger shields	28 June	....	....	62
Nossiter	Leather	10 Oct.	....	....	303
Orsi	Sleepers	23 Oct.	....	....	304
Orton	Life-boats	27 Oct.	....	....	382
Oxley	Propelling vessels	21 Aug.	....	....	160
Palmer........	Mine lifting machinery ..	15 Nov.	....	....	383
Paltrineri......	Motive power..........	30 Aug.	....	....	159
Parkes	Coating metals	9 Oct.	....	....	288
Parkhurst	Propelling vessels	17 Nov.	....	....	383
Parlour.........	Propelling vessels.......	20 Nov.	....	....	383
Parsey	Obtaining power	....	6 June	....	63
Parsons	Fuel	....	8 Aug.	....	160
Pearse	Sugar	21 Aug.	....	....	160
Perkins	Heating and evaporating .	21 July	....	....	62—384
Perkins........	Steam engine..........	18 Sept.	....	....	223
Perrier	Spinning	21 July	....	....	63
Pinkus	Motive power..........	....	17 July	....	112
Polkinghorne ...	Ores	18 Sept.	....	....	223
Pollard........	Gases	....	30 July	....	160
Poole	Railway rails	6 Oct.	24 Sept.	....	288—304
Poole	Raising and transporting earth, &c..........	18 Nov.	....	....	383
Poole	To prevent oxydation of iron	27 Nov.	19 Nov.	....	384—447
Poole	Locks................	4 Dec.	....	....	447
Poole	Drawing..............	10 Dec.	....	....	448
Poole	Stopping bottles, &c.....	12 Dec.	....	....	448
Pooley	Spinning machines......	....	24 Sept.	....	304
Powell	Carriages	18 Nov.	....	....	383
Prosser........	Metal tubes	....	18 Nov.	....	384
Quick & ano.	Expansive steam and atmospheric engine..	12 July	....	....	62
Quick	Steam engines.........	....	12 June	....	63
Quick	Atmospheric railway	31 July	....	....	159
Quick	Steam engines.........	9 Oct.	....	....	288

Name.	Subject.	England.	Scotland.	Ireland.	Page.
Van Vost......	Seeds................	6 Oct.	....	....	288
Vaux	Warming boots	4 Sept.	....	....	123
Vaux	Tilling land	11 Nov.	....	....	383
Vaux	Prevention of accidents on railways	18 Nov.	....	....	383
Vidocq........	Tea-tray..............	20 Nov.	....	....	384
Walker and ano.	Railway springs, &c......	3 July	....	....	62
Walker........	Piano-fortes	10 Oct.	....	....	288
Walker	Sluice cocks	31 Oct.	....	....	382
Ward	Obtaining a vacuum for railways	18 Nov.	7 Oct.	....	383—304
Watney	Horse shoes	3 Nov.	12 Nov.	....	382—384
West..........	Bottling..............	16 Oct.	....	....	303
Wheatstone&an.	Electric telegraphs......	....	2 July	....	112
White	Water machinery	27 Nov.	......	....	447
Whitehead	Wool and flax	10 Oct.	....	....	288
Whiting	Hats	....	17 June	....	63
Williams	Wrenches	10 Dec.	......	....	448
Williams	Waterproofing paper, &c.	21 July	....	....	62
Williamson	Motive power..........	10 Oct.	....	....	288
Wilkins	Leather	....	7 Nov.	....	384
Wilkinson	Filtering..............	8 Dec.	....	....	448
Wilson........	Spinning..............	29 July	6 Aug.	....	159—160
Wilson........	Soap	10 Oct.	....	....	288
Wilson........	Turntables	18 Nov.	....	....	383
Wilson........	Candles	20 Dec.	....	....	448
Woodcroft	Propelling vessels	....	24 Sept.	....	304
Worsdell	Railway carriages	23 Oct.	....	....	304
Wright........	Gas metres............	....	12 July	....	112
Wright........	Sugar refining	18 Nov.	....	....	383
Wylam........	Fuel	....	16 Sept.	....	224
Yates	Plaster and cement	....	28 July	....	160
Yglesias	Motive power..........	13 Nov.	....	....	383
Young	Electricity	4 Aug.	12 Aug. (ane)	....	159—160

68